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# ANNALS *of* SURGERY

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## NOTES ON MILITARY SURGERY

BY GEORGE W CRILE, M D

OF CLEVELAND, OHIO

(From the service of Lakeside Unit, American Ambulance, Neuilly-sur-Seine, Paris, France)

At the outbreak of the war a group of Americans in Paris, aided and encouraged by our able American Ambassador, mobilized the resources at hand and with surpassing dispatch organized a most efficient hospital of 450 beds. In general it may be said that probably never before in the history of hospitals has one been governed by an organization of such talent and such deep consecration as is found in this group of business, professional, literary, artistic, diplomatic men and women. I cannot sufficiently express my admiration for the achievement of this group of individuals in so efficiently expressing their sympathy for the injured soldier. The hospital was organized under the charter of the established American Hospital of Paris, and is known as the "Section for the Wounded." The hospital is located in Neuilly, a suburb of Paris, in a beautiful new building intended for a high school. The organization is efficient, the management excellent, the cuisine under Frascatti, and the personnel talented and cosmopolitan.

The American Ambulance is under the direct control of the War Department, of which Dr Winchester Du Bouchet, the Surgeon-in-Chief, is the direct representative. There are four services, three of one hundred beds each, under Dr Du Bouchet, Dr Joseph A Blake and Dr Mignot, and the University Service of one hundred and fifty beds. In the course of discussions of the problems of the American Ambulance it was suggested that it would be to the mutual advantage of American surgery and of the American Ambulance, if certain of the teaching Universities were to form units to take charge of one division of the American Ambulance for a period of three months each. To a letter from Dr Joseph A Blake favorable response was made by Harvard University, the University of Pennsylvania, Chicago University, Western Re-

serve University, and other universities are giving it consideration. It was the desire that each university should finance its unit, and that each unit should consist of a sufficient number of surgeons and nurses to carry on the work of the operating room, and the surgical care of the patients in the wards. The nursing care of the wards was assumed by the American Ambulance. The Medical Board, according to Dr. Blake's letter, felt that in this way a considerable group of American surgeons would become familiar with military surgery, and in turn would disseminate their knowledge so that a more intelligent conception of this branch of surgery would in some measure prepare us for possible need in our own country. It was not intended that the universities should assume any unneutral position, any more than surgery or science is unneutral. It was believed also that by this means the interest of the participating universities would be kept more closely in touch with the relief problems of the war. Furthermore, it was hoped that this action on the part of the universities would stimulate in the cities in which they are located a personal interest in the American Ambulance.

The Medical Board of the American Ambulance set apart the entire third floor of the hospital for the University Unit. This comprised nineteen wards of eight beds each, and two large, well-lighted rooms for an operating room and research laboratory. These two rooms were originally designed for draughting rooms and so had a northern exposure and were provided with skylights. It will be seen therefore that the management and the Medical Board of the American Ambulance were exceedingly generous in putting at the disposal of the American University so large, commodious and well-equipped a service.

I must add here that from the beginning to the end of the service of the Lakeside Unit of Western Reserve University the greatest courtesy and helpfulness were manifested by the management, by the Ambulance and by its Medical Board.

Under the management of Dr. Gros the Ambulance Department itself has rendered extremely efficient service. The ambulances of the American Hospital operated all along the line up through northern France into Belgium—wherever their services were most required. At the conclusion of my service I had the opportunity of paying a visit to the principal ambulance stations in France and Belgium. Everywhere I found that the ambulances were kept in splendid condition, and were operated most efficiently, the drivers being for the most part Americans—college men, polo players, hunters, and soldiers of fortune. Thus far there have been no fatalities among the ambulance men,

## NOTES ON MILITARY SURGERY

although there have been several narrow escapes, especially during the recent aerial bombardment of the railway station at Dunkerque when some damage was done to several of the ambulances, but the men were uninjured

*Nursing*—The professional nurses of the American Ambulance were efficient and their personnel was most cosmopolitan. Sixty-three hospitals and thirteen nationalities have had representatives in the nursing corps. The heads of the wards and departments were professional nurses, these were assisted by volunteer auxiliary nurses, among whom were artists, authors, actresses and social leaders. Those auxiliary nurses who had been on duty since the ambulance opened had obtained a high degree of efficiency. They were punctual, obedient and devoted to their work, and many of them have become extremely proficient.

*Orderlies*—The orderlies were volunteers also. Aiding them there were students, artists, authors, singers and noblemen. In one of our wards an orderly—a count—routinely had mounted in gold the bullets and shrapnel surgically removed from the soldiers. The personnel of this hospital is practically the same as in the hospitals of all of the warring nations, but it so happens that in the American Ambulance there is an unusual concentration of talent in all its departments. It certainly was not without surprise that one found among the orderlies in a ward men who had made great names as painters, sculptors, authors, or who held high positions in financial and political life.

*Management*—In its efficiency the management could bear comparison with the best institutions anywhere. The cost of maintenance is lower than that in a hospital of equal efficiency under normal conditions.

*The Lakeside Unit*—The Lakeside Unit consisted of a chief and four members of the graded surgical staff of the Lakeside Hospital who were residents in the American Ambulance under the same conditions and the same organization as when on duty in the Lakeside Hospital, a neurologist, an internist, two anæsthetists, two operating room nurses, and two research workers.

The first feature of the service to impress one coming from civil practice was that only able-bodied young men were seen as patients. We had in our wards not only French soldiers, but Turcos also, and some English. The soldiers exhibited a splendid moralé, rarely complained no matter how severe their lesions, they showed marked resistance to infection and exhibited a high power of repair. I was quite unprepared to find the French soldier so stolid.



Immediately after arrival the University Unit received from ten to thirty-nine patients every day, until the service of one hundred and fifty beds was filled. For the most part the patients were admitted at night. Normally from five to ten operations a day were performed. As compared with the work in civil practice, these operations were far simpler in technic, the outstanding difficulty, as pointed out by Dr. Blake, being judgment regarding the proper procedure in the more severe infections. I believe I have never known more difficult problems in infection than those presented in this service.

*Anæsthetics*—Many operations being relatively short and performed upon very sick patients—exhausted, exsanguinated, extremely septic—nitrous oxide-oxygen proved to be the ideal anæsthetic. We took with us a supply of this anæsthetic and two anæsthetists skilled in its use and administration. Its great advantages were at once so apparent that our anæsthetists and supply of gas were utilized by the other services, especially in critical cases. Our anæsthetists found that the French soldier presented a different problem than the average civilian patient in this country, in this respect, that while the stage of induction was longer and more difficult, after the induction was completed, they required a relatively smaller amount of the anæsthetic and it was easier to maintain a smooth and even anæsthesia. A similar difficult induction in our patients at home would indicate a certain amount of alcoholism. It is probable that the more common use of alcohol among the Europeans would account for the generally greater difficulty in anæsthetizing patients. This difficulty is notably manifested in the use of ether. The French patients responded quickly at the close of the operation and many of them were able to walk back immediately to their wards. During anæsthesia, especially during its induction, the patients would frequently experience exciting dreams of battle.

The most interesting operation performed during our service was performed by my associate, Dr. Wm. E. Lower, who successfully removed a bullet from the pericardium.

*Infections*—The greatest outstanding problem in the surgery in a base hospital is that of infections. Almost every wound was infected. Despite the perfection in technic in aseptic surgery in civil practice, in military surgery asepsis has failed. Antiseptics have failed. The type of infection depends in a measure on the type of injury, on the state of the soldier, and on the length of interval before the wound receives adequate treatment (Fig. 1).

Much of the soil of France and Belgium for generations has been under a high degree of cultivation involving the use of much manure,

which is laden with gasogenic bacteria, such as tetanus and the Welch bacilli, which cause gas gangrene

As the military operations of the present war are carried on almost wholly in trenches the clothing and skin of the soldier become laden with these germs, which the ball or shrapnel carries into the tissue. The type of wound has an important bearing upon the question of infections. Rifle balls usually make clean-cut wounds, only occasionally carrying clothing into them. Shrapnel and shell very commonly carry clothing into the wound—the highly infective clothing being a dangerous factor. In addition, the injuries from shell or shrapnel differ locally from a rifle injury in the following respect. The former produces a larger zone of contused and particularly devitalized tissue, which has a low resistance to infection. Most cases of gas gangrene follow shrapnel and shell wounds. Hence surgeons are now promptly treating these wounds by clearing out foreign bodies, excising the devitalizing tissue, and providing good drainage.

As to the treatment of wounds when once infected, I gathered from the leading surgeons in the British and the French armies that there has been no material progress made since the Franco-Prussian war. It has been said that the discovery of an efficient antiseptic would be worth 20,000 soldiers to the French army. As I have stated already, asepsis has failed, antiseptics have failed. Therefore, as pointed out by Sir Berkeley Moynihan, along this line the surgeon must begin his work afresh. Sir Almroth Wright and his staff at Boulogne are engaged in important researches, and progress is being made by them in combating infections, and doubtless there are extensive researches in progress elsewhere.

Under the auspices of the Rockefeller Institute, Alexis Carrel has gathered together a strong research group, including Dr. Dakin, who are to conduct a research into infections in a hospital near the line at Compiègne. This move is strongly seconded by Professor Tuffier. It is the belief that some new means of chemically controlling infection must be found. Sir Almroth Wright and Sir Berkeley Moynihan have pointed out the shortcomings of dry dressings which, by holding the products of infection close upon the wound, form a pus poultice. This pus poultice not only interferes with wound healing, but causes the absorption of poisonous enzymes. These observers advise warm moist dressings, immersion in hypertonic solutions of potassium citrate and sodium chloride, and, in severe knee or thigh injuries, the immersion of the patient in a bath. In our University division at the American Ambulance we tried the open-air treatment, after a certain

stage was reached, and apparently secured better results than with dressings. The exposure of wounds to the electric light is especially advocated by Dr Du Bouchet. Hot packs, immersions in hot water, free incisions, good drainage, physiologic rest, seem up to this time to constitute the best treatment.

*Gas Gangrene*—Gas gangrene has been studied by Professor Weinberg, of the Pasteur Institute, and Dr Jablons, Pathologist of the American Ambulance. Beyond a note by Weinberg these researches have not been published. One point seems quite clear, that is, that in many wounds many tetanus and gas bacilli may be found and yet neither tetanus nor gas gangrene may develop.

The clinical phenomena—*viz*, fever, rapid pulse, increased respiration, sweating, delirium, unconsciousness and death—and certain researches in my laboratory in association with Dr Austin and Dr Hitchings on the effect on the kinetic system of toxins and infections lead me to the opinion that death from gas gangrene is caused by structural injury of the brain, the adrenals and the liver. The odor of these cases is apparently that of indol and skatol, and in my laboratory we have shown that indol and skatol cause identical lesions of the brain, the adrenals, and the liver. No specific treatment has yet been found. Hope is entertained that a serum made at the Pasteur Institute by Professor Weinberg may be useful. Continuous oxygen infusions in the tissues beyond the advancing margins is favored by some. Prompt amputation, leaving the stump wide open and applying peroxide of hydrogen, apparently yields the best results.

Very free incisions and heavy cauterizations are advocated by others, but the mastery of this disease is for the future.

*Shock and Exhaustion*—Next to infection shock and exhaustion have probably killed the greatest number of soldiers. The emotional factor in many instances is a serious menace, for example, in the case of men distressed by being cut off from the main body of troops and of wounded men lying in the zone of rifle fire in the area between the first line trenches of the opposing sides, where wounded men may lie under fire until night and sometimes at night even cannot be rescued. In the fully-manned first line trenches, which extend well across the continent, there are always intense emotional activations during both day and night. The emotional strain is especially great when the opposing trenches are separated by only fifty yards or less and each is filled with brave resourceful men with splendid equipment for killing. In the early part of the war when the law of the survival of the fittest was relentlessly applied, many men in all the armies fell

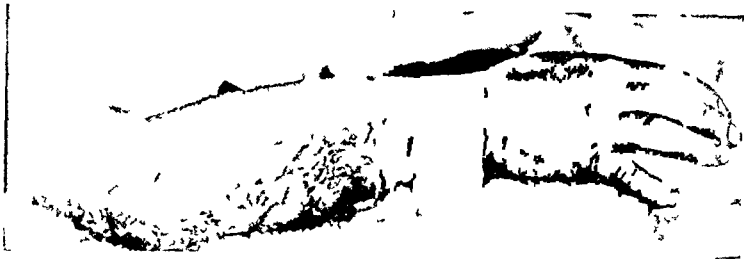
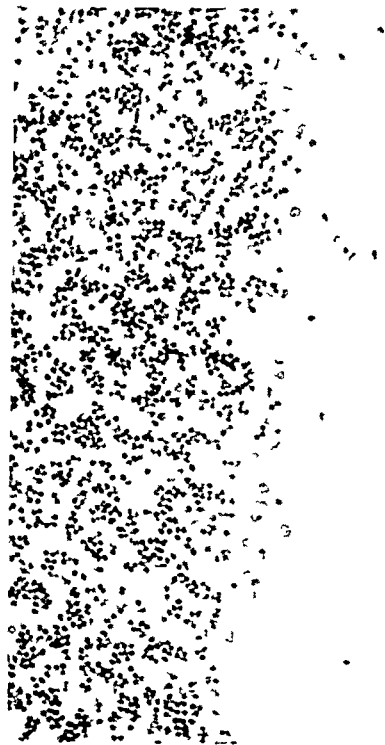


FIG 1—Case of perforating shrapnel wound of right forearm with fracture of both bones and infection (Service of Lakeside Unit American Ambulance Neuilly-sur Seine Paris France)



A



B

FIG 2—A Section of normal cerebellum B Section of cerebellum of soldier who was wounded while fighting in the trenches in France. His wound was not dressed until about four hours later and it was four days before he reached the American Ambulance, where he died after an operation for resection of the fractured head of femur. He was without food for nine hours. This shows the disintegration of the Purkinje cells caused by the combined effects of emotion, exhaustion, loss of sleep, pain, infection and surgical shock.

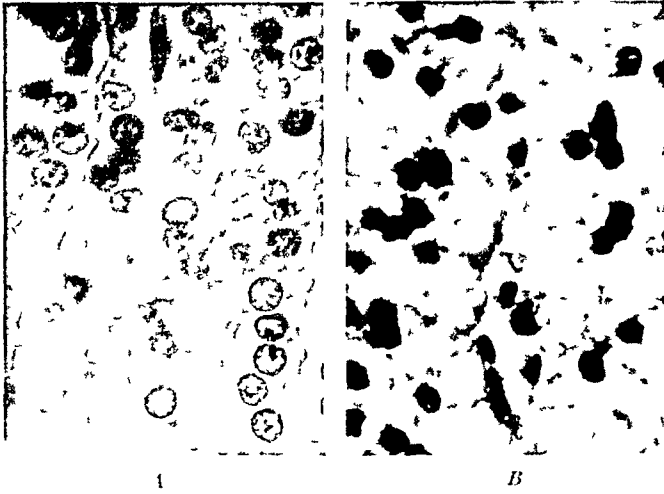


FIG 3 — *A* Section of normal adrenal *B* Section of adrenal of soldier described in preceding figure The general disintegration of the cells loss of cytoplasm misshapen and eccentric nuclei illustrate the effect of emotion exhaustion lack of sleep pain infection and surgical trauma

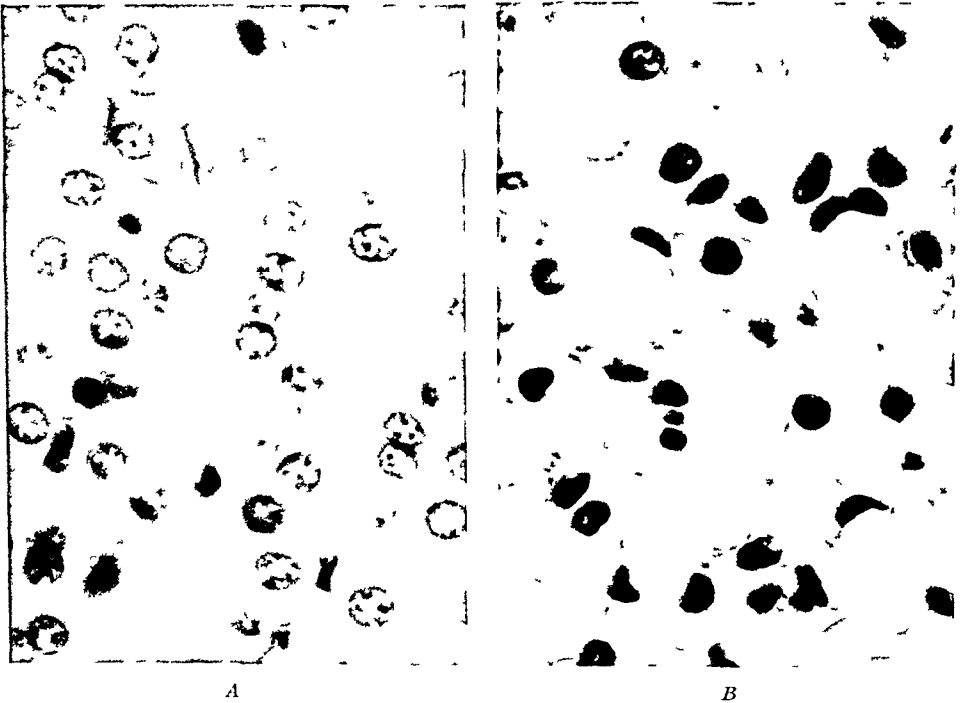


FIG 4 — *A* Section of normal liver *B* Section of liver of soldier described in former figure The general disintegration of the cells the loss of cytoplasm and the vacuolated spaces within the cells illustrate the effect of emotion exhaustion lack of sleep pain infection and surgical trauma

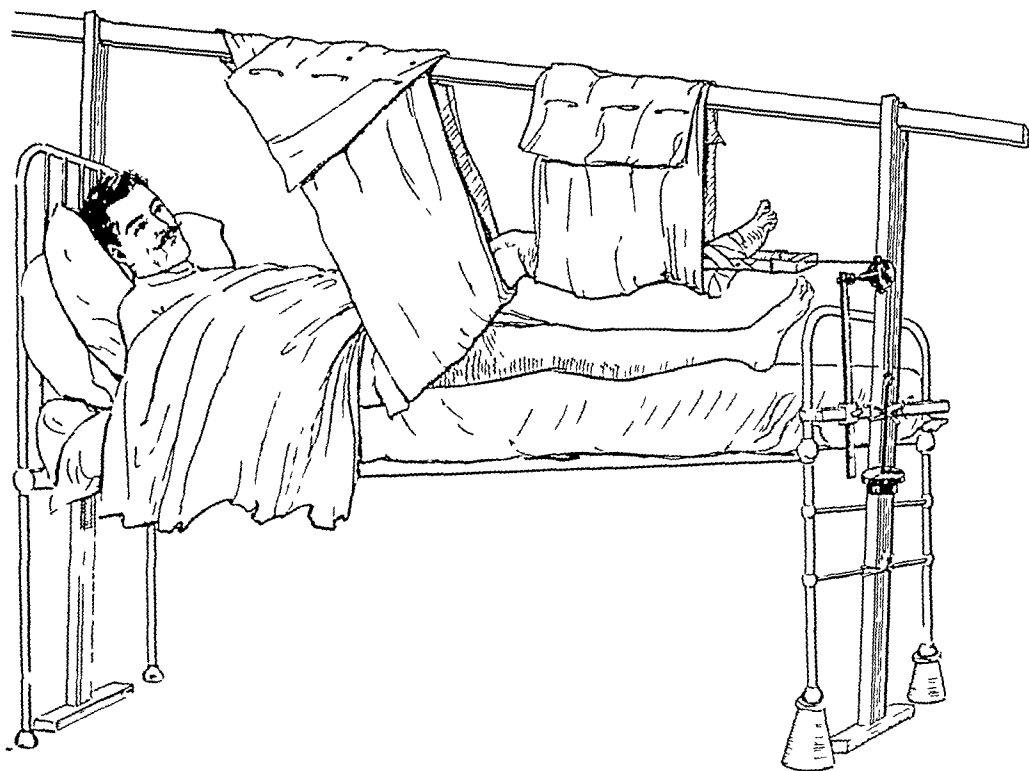


FIG 5 —Balkan splint as used at the American Ambulance Neuilly-sur-Seine Paris France

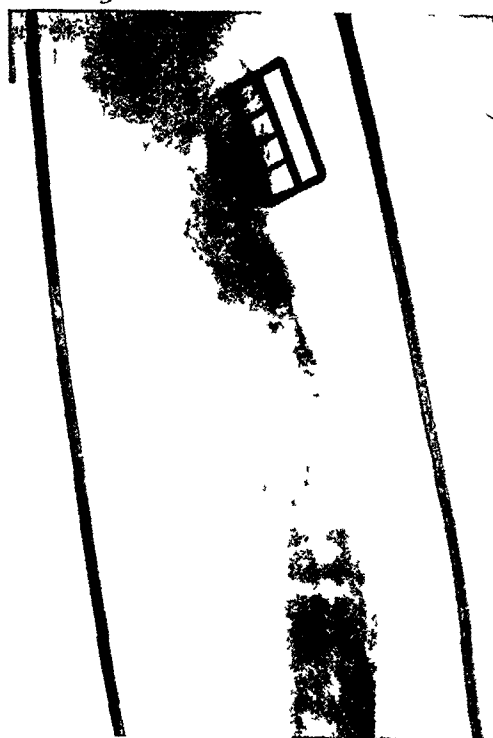


FIG 6 —Compound comminuted fracture of middle third of left humerus Note the shattering and deletion of bone caused by a bursting shell (Service of the Lakeside Unit, American Ambulance Neuilly-sur-Seine Paris France)



FIG 7—Lesion of external cutaneous nerve of thigh and of long saphenous nerve of leg caused by rifle ball which entered just below right knee and emerged as shown (Service of the Lakeside Unit American Ambulance Neuilly sur Seine Paris France)



FIG 8—Frozen feet (Service of the Lakeside Unit American Ambulance Neuilly sur-Seine Paris France)

under the emotional strain By the process of elimination and hardening the emotional strain is diminishing There have been numerous examples of complete breakdown without any injury There are innumerable cases in which very slight injuries have caused great shock—even death As for the treatment of shock, under the almost inconceivable difficulties encountered in the larger engagements, the best that can be done is to give morphia When from three to five thousand wounded must be cared for by a few surgeons only, it is idle to think of any treatment—many of the wounded cannot secure a drink of water, even (Figs 2, 3 and 4)

*Hemorrhage*—Secondary hemorrhages may occur, for the relief of which successful transfusions of blood have been made

*Transplantation of Limbs Blood-vessel Suture*—The exigencies everywhere existing, the difficulty in controlling an absolute aseptic technic, have prevented thus far successful transplantation of limbs But it is hoped that later on conditions may be so controlled that the transplantation of limbs and blood-vessel suture may have a fair trial The most important blood-vessel surgery will probably come after the war

*Head*—Head injuries do very well at first, but later certain secondary changes develop, such as abscesses, and epilepsy

In the hands of American dentists—especially in the American Ambulance—wounds of the jaws and mouth have been treated with remarkable success This wonderfully successful work in oral sepsis, in transplantation of teeth, in fashioning dental splints, in fabricating sustaining bridges, and in overcoming defects is one of the excellent products of the war

*Chest*—Penetrating rifle wounds of the chest do very well There is usually a quick convalescence and an early return to the front In some instances, however, a pleurisy develops after the wound seems to have healed On the other hand, in the case of penetrating shell and shrapnel wounds empyema nearly always develops

*Abdomen*—Penetrating wounds of the abdomen have baffled the surgeon Even in the most skilful hands immediate operation usually ends fatally, death being due to shock and infection Occasional cases recover with or without operation I expect later to hear a more favorable report regarding these cases from the Belgian Field Hospital, which is situated near the front

*Pelvis*—Wounds involving the bladder or ureters with shattering of the pelvic bones usually end fatally The struggle is prolonged but futile



*Extremities*—High compound fractures of the thigh with great shattering of bone offer special difficulties, first the difficulty of transportation, then of shock and exhaustion, finally the inevitable infection. These cases call for the keenest judgment, for a decision to amputate depends upon the physical state of the patient, on the chances of transportation to a base hospital, on the length of time that will probably be spent in transit, on the probability of gas infection, on the equipment at the field hospital behind the line of battle, and on the ability and equipment of the surgeon in charge.

Shattering of the knee-joint presents a difficult problem, but these cases are more easily transported. Injuries of the leg and foot are easily supported for transportation. A shattered shoulder-joint, though far more amenable to treatment than the thigh, still presents much difficulty, especially when the infection spreads up over the shoulder to the neck, so that should gangrene occur the incision must pass through dangerously infected tissue.

The handling of vast numbers of compound fractures has brought out some new splints. Blake's splint is satisfactory, as it has the advantage of lightness, of simplicity, of giving excellent counter-pressure, of affording good room for dressings, and of admitting the free use of Buck's extension. Blake's splint also facilitates transportation and simplifies the taking of X-ray pictures.

Perhaps the most popular splint in the British service is the Balkan splint, one of the few useful products of the Balkan war. It is cheap, simple, can be made by anyone, can be used in many ways, and dispenses with coaptation splints and bandages. It consists of two wooden upright pieces at each end of the bed, the one at the head being higher, these two upright pieces support a ridge pole extending over the patient from the foot to the head of the bed. From this "ridge pole" the leg or arm is slung in slings, the extension apparatus being attached to the upright at the foot of the bed. By this means the limb is kept under extension and in an elevated position. This appliance gives the patient a large range of movement, gives the nurse good opportunity for work, permits dressings without movement, dispenses with splints or dressings, keeps off the weight of bed-coverings, and by the elevation of the limb swelling is minimized. We are introducing it into the wards of Lakeside Hospital (Fig 5). Bone plating is used but little—but one surgeon is testing the value of the use of long Lane plates to facilitate transportation.

*Repair of Infected Compound Comminuted Fractures*—After seeing the almost unfailing repair of widely shattered shafts of bone, the

wounds filled with shrapnel and clothing, neglected and exposed, one must renew his faith in the reparative power of nature. I have the conviction that with time and patience any bone will repair itself even if the destruction be extensive and infection be present. Dr Du Bouchet, Dr Blake, and Dr Mignot showed me some wonderful cases of extensive bone repair (Fig 6)

*Aneurisms*—True aneurisms are in the process of formation and will not be in evidence until nearly a year has elapsed. There are many false aneurisms, however. Those have been most successfully handled. Simple ligation is usually sufficient. In the University service we ligated the brachial artery, but took the precaution to compress it for hours at a stretch at frequent intervals in order to force a collateral circulation in advance of ligation. Before dissecting out the false aneurism we also assured ourselves as to the competency of the collateral circulation by Matas's test. The result was excellent.

*Peripheral Nerves*—In a base hospital one finds many lesions of the peripheral nerves and some lesions of the spinal cord and brain. A base hospital should therefore have the services of a neurologist. Dr C W Stone, the neurologist of the Lakeside Unit of Western Reserve University, found much interesting material (Fig 7). We soon found that total "physiologic" cross lesions by no means indicated anatomical cross lesions. In fact one was surprised again and again by the escape of nerve trunks—apparently they are pushed aside by the missile. In one instance I isolated the nerve and found it not divided, but much swollen, obviously having been much contused. I isolated a distance of about two inches, fashioned a fascia-fat flap from the adjacent tissues, wrapped the fat side of the flap around the bruised, swollen musculospiral as a protecting sheath, and held it in place by several stitches. There was early restoration of function.

*Pseudo-Frost-bites*—A large number of cases of so-called frost-bite were seen, especially in the earlier months. The weather in northern France and Belgium is quite mild as compared with the temperature in this region of the United States and it was soon apparent that the so-called frost-bite was not due to the cold alone, but that it occurred as a result of the combination of three factors, moderate cold, dampness and tight-fitting shoes and leggings. It was stated that no one of these three factors alone would have caused frost-bite, but that this lesion was the result of standing in water for a long stretch of time, while shrinking shoes and leggings interfered with the circulation, together with the moderate cold.

We found the best treatment was to keep the feet cool and dry by

the application of stearate of zinc powder and exposure to the air. If gangrene had developed it was in most instances superficial. Though sloughing of the external parts was frequently observed, amputation was rarely necessary (Fig. 8).

*Researches*—If this war has taught us anything it is that there is a most urgent need of research into the control of infections. As we cannot depend now upon Europe for this research, it becomes the clear duty and obligation of the profession in the United States to undertake it. It would be very desirable if the various civil laboratories and medical schools would take up this serious problem, especially with the point of view of discovering a chemical agent that will strike down infection after its initiation.

*Conclusion*—In the early stages of the war when suddenly hundreds of thousands of wounded soldiers were flung hither and thither—and men untrained as surgeons had to acquire their experience at the expense of the soldier, the soldier not only had to pass through untrained hands, but these untrained hands had meagre facilities for their faltering work. This apparently is a part of the grist of the war mill. The army surgeon is relatively untrained in surgical practice, but he is highly trained in organization, transportation, emergency field work, all of which are of the utmost importance. On the other hand, although the civilian surgeon is untrained in military organization and transportation and field work, yet he is highly trained in the actual care of the patient. Obviously, therefore, the best results will be achieved by having the army service take charge of the field service and by placing the heavy surgical work of the base hospitals in charge of civilian units, and by having attached to each base hospital a board of consultants or inspectors composed of the most expert surgeons—practical surgeons upon whom can be placed the responsibility of the practical work and the formulation of general principles.

There are vastly important lessons to be learned from this war and a great service to be rendered. For the service it may render in the present and the good that may accrue to the future our country should not fail to avail itself of this opportunity.

# SARCOMA OF THE BREAST

BY S H GEIST, M D <sup>1</sup>

AND

A O. WILENSKY, M D

OF NEW YORK

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JUDGING from the literature, one is forced to regard sarcoma of the breast as a comparatively uncommon disease. With few exceptions the contributions are limited to isolated case reports, or detailed studies of specific histological types.

Our material for the past ten years comprises 558 cases of breast tumor, including chronic inflammatory growths, both simple and specific. It was found that 22, or 3.9 per cent, of these were sarcomata of various types, 260, or 46.5 per cent, were carcinomata. Of the malignant tumors 7.7 per cent were sarcomata. These figures may not represent the true relative proportions, as undoubtedly many of the cases of definitely benign tumors were not sent to the laboratory for histological examination.

According to their histological types, the 22 sarcomata are grouped as follows:

Fibromyxosarcoma	5	Cystosarcoma phylloides	4
Spindle-cell sarcoma	5	Giant-cell sarcoma	2
Round-cell sarcoma	4	Perithelioma	2

The fibromyxosarcoma and spindle-cell sarcoma are the most common types. Grossly, they vary in size depending on the length of time and the rapidity with which the tumor has been growing. The spindle-cell type is a lobulated tumor, firm and elastic to the touch, with a striated, whitish or pinkish cut surface. It often shows a capsule which may be complete, or defective in places. The fibromyxomatous tumor on the whole resembles the spindle-cell type, except that the former is usually softer and more succulent, and may even present small cystic and translucent areas.

Histologically, the spindle-cell tumors are composed of masses of rather small spindle-cells, with scanty protoplasm and elongated, deeply-

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\* Work done under the tenure of a George Blumenthal, Jr., Fellowship

staining nuclei, without definite arrangement. Occasionally there is a tendency for the cell masses to group themselves about the blood-vessels. Multinuclear cells are found infrequently in these tumors. They are somewhat larger than the normal cell type, and contain two or three small nuclei arranged in the centre of the cell and almost filling it. Mitotic figures are present but are usually not very numerous. Fibromyxomatous tumors represent the same type of growth and are likewise composed of spindle-cells, which, however, are scattered in a matrix that shows œdema and myxomatous degeneration. In some of these degenerated areas branching cells are found supported in a mucoid stroma, that takes a purplish-blue tint with the hæmatoxylin stain. The origin of these two types of tumors is, in all probability, the interstitial connective tissue of the breast. The difference between the two consists of variation in the amount of intercellular tissue and the presence of degenerative changes in the stroma. The tumors grow slowly as a rule, and often remain well encapsulated for long periods of time. We consider some of these tumors to be midway between benign and malignant growths. Lymph-nodes in these cases show no tumor involvement.

The other types of sarcoma occurred with about equal frequency. Round-cell sarcoma, as we found it, was a rounded, smooth, firm tumor, usually single and occasionally multiple, in one or both breasts, and of fairly rapid growth. With this type of tumor the tendency was sometimes exhibited for the growth to break through the capsule and to invade the skin and deeper structures. The tumors on section have a cellular, whitish and homogeneous appearance. Scrapings from the cut surface show an abundant cellular content.

Histologically, the cells are round or oval in shape and distributed in groups. These tend to show a radial arrangement to the vessels, or are massed in large strands separated by fine fibrous tissue bundles. Relatively few mitoses are present. In this type of tumor it was possible to demonstrate by special staining methods (Bielschowsky) the presence of a fine fibrillar reticulum ramifying between the individual cells. Histologically the lymph-nodes are occasionally involved by tumor cells.

In two of our cases a previous diagnosis of primary lymphosarcoma of the breast had been made. The gross and histological pictures of these tumors correspond accurately with those of the round-cell sarcoma. We were unable to demonstrate that lymphoid tissue occurred normally either in the breast proper, or in the skin overlying it, nor could we find references in the literature to its occurrence, and we were forced to conclude that lymphosarcoma does not occur primarily in the breast,

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and that the tumors so classified heretofore were in all probability small, round-cell sarcomata. We believe these tumors to have their origin in the interstitial tissue of the breast and that the cell type is really an undeveloped connective-tissue cell, or at least one that has not reached full maturity.

The relative proportion of cystosarcoma phylloides in our series differs from that given by Poulsen, Williams, Kausch and Finsterer, who found a predominance of this type of tumor. We may account for the discrepancy by the fact, that in these oedematous breast tumors, we are extremely conservative in our diagnosis of sarcoma, believing that most of them are fibro-adenomata with interstitial oedema. Only those cases in which the stroma shows marked cellular proliferation are classified as true sarcomata.

In our four cases the tumors were rather large, the largest being the size of a grapefruit. They are well encapsulated, irregularly lobulated, and soft tumors, usually involving one breast only, and are distinguished, grossly, by showing oedematous, papillary, intracystic excrescences. Occasionally they present large cystic spaces, containing a yellowish fluid in some, and a more buttery substance in others.

Histologically, these club-shaped, and irregularly papillary, intracystic excrescences are composed of masses of periductal tissue projecting into dilated and cystic duct spaces. These spaces are lined by cuboidal epithelium which, in places, may be stratified. The stroma of these excrescences is markedly cellular. The cells themselves are closely packed, short spindle-cells with scanty, pale staining, granular protoplasm and a centrally placed, elongated nucleus. The ground substance presents an oedematous granular appearance. Atypical cell types, mitoses and other indications of rapid proliferation are missing, and on the whole the histological picture indicates a comparatively benign tumor.

The lymph-nodes, while not involved, always show a marked endothelial hyperplasia.

The tumor, as we have seen it, appears as a homogeneous, oedematous fibro-adenoma, in only part of whose extent the characteristic intracystic excrescences are present. Microscopically one gets the impression that these are due to a sarcomatous change in the periductal tissue, which mechanically causes the characteristic gross appearance.

The giant-cell sarcoma is a tumor of rapid growth. Our specimens were pear-sized tumors, encapsulated, and rather soft in consistence. On section they appeared succulent with varying areas, some rather vascular, others seemingly necrotic.

Histologically, these tumors consist of mono- and multinuclear giant-

cells which exhibit the tendency to arrange themselves in alveoli and to group themselves about the blood-vessels. The individual cells are large, polyhedral, or round, and have good-sized nuclei of irregular shapes, with deeply staining chromatin network. The giant-cells are predominant in the histological picture, although spindle- and round-cells are scattered very freely throughout. The cells show evidence of rapid proliferation, both mitotic and amitotic types of cell division being numerous. The entire structure is traversed by numerous dilated, thin-walled blood-vessels whose growth frequently does not keep pace with the actual tumor growth, areas of necrosis and hemorrhage are, therefore, of common occurrence. Inflammatory zones are also found scattered throughout.

In our studies we were unable definitely to formulate an idea as to the histogenesis of this type of tumor. In all probability it, too, represents a growth arising from a connective-tissue cell of the interstitial tissue.

The peritheliomata in our series were rounded, somewhat cystic tumors, well encapsulated and of rapid growth. They are single tumors and do not involve the surrounding tissues. On section they have a reddish color and appear very cellular. Histologically, they present branching masses of cells arranged about the blood-vessels. In places these cell masses can be traced into dilated spaces. Some areas present a tendency toward the formation of gland-like structures, between which there is a very cellular stroma. The cells are round, oval, or polyhedral in shape with oval or rounded, large, deep-staining nuclei, and little cytoplasm. Hyaline and myxomatous degeneration of the stroma is often seen. These tumors, in all probability, arise in the perivascular lymph-spaces.

An analysis of the symptomatology of these tumors shows no specific differential points which would enable one to distinguish, clinically, between the various types. The tumors occurred in women between the ages of twenty-nine and forty-nine years, the average being thirty-nine years. All the women were married, and the majority had borne children. In one patient, who had a round-cell sarcoma, the history obtained was that the appearance of the tumor coincided with the inception of lactation. It is, however, more probable that the tumor was present prior to the lactation period, and that its growth was vastly stimulated by the increased physiological activity. In two cases, one a fibromyxosarcoma, and the other a cystosarcoma phylloides, a history of trauma was obtained. In three other cases there was a history of a previous inflammatory condition. In two of these instances, both of them cystosarcomata, there was a history of mastitis, one eight years and one four

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years previously In the third case, a perithelioma, a breast abscess had occurred twenty-seven years previously, on the same side

In three instances there was a history of a previous breast tumor, in two of these the tumors were in the opposite breast In the first of these three cases, the first tumor had been removed six years before the appearance of the second, in the second case, one year previously, in the last case both tumors had appeared about the same time, the removal of one of the tumors antedating the removal of the second by two years In no instance have we records of the histology of the first tumors removed

In 57 per cent of the patients the right breast was involved, in 33 per cent the tumors were bilateral, and in 10 per cent the tumor grew in the left breast We lay no stress upon these figures, inasmuch as the total number of our cases is insufficient to enable us to draw conclusions The duration of the tumors varied from a period of one week to nine years, the size varied from that of a walnut to that of an adult's head We have the impression that the size of the tumor depended to a very large extent on the length of time the tumor had been growing

The tumors all grew fairly rapidly, the one previously mentioned as having attained the size of an adult's head, had the longest duration, and even it had been noted to grow more rapidly in the last year It seems rather characteristic of sarcoma of the breast, that the tumors show a period of latency and then, for some unknown reason, begin to grow rapidly This could be accounted for by the fact that many of these sarcomata have their origin in previously benign tumors Pregnancy, lactation, and trauma seen also, to a certain extent, to act as stimuli to the growth of these tumors

In one-third of the cases, the skin was fixed to the tumor, in these instances it was thinned, reddened, and tense In two cases there was simply an erythema, and the skin, though tense, was movable over the tumor In only one case was the skin ulcerated, and that in a fibromyxosarcoma, which had grown to the size of an adult's head in six years' time The skin in the neighborhood of the tumors usually showed dilated and radiating veins

Pain existed as a prominent symptom in one-third of the cases It was also noted that two-thirds of these were associated with tumors that involved the skin We believe that the pain is due to compression, or stretching of the cutaneous nerves by the growing tumor, and in rare instances by actual involvement of the nerves

The tumors do not, as a rule, show much tendency to infiltrate the deeper tissues



In one case the nipple showed retraction, the tumor, a spindle-cell sarcoma, being situated just below it. In none of the cases was any secretion present.

The lymph-nodes rarely showed metastatic involvement, although in almost every instance large, soft nodes were palpable in the axilla, and occasionally in other regions, such as the supra- and infraclavicular fossæ. Microscopically, these nodes usually showed hyperplastic changes, and this was most marked with cystosarcoma phylloides. The one instance in which metastatic tumor was present in the lymph-nodes was a round-cell sarcoma.

Of the 22 cases in our series, 11 were subjected to the radical Halstead operation, one case had an amputation of the breast and dissection of the axilla, in one, a simple breast amputation was done, in five the tumor itself was excised, in one only a specimen was removed, and in the remaining three cases the type of operation was not described. With the exception of one patient, who died shortly after the operation, all the patients left the hospital in good condition.

In three cases there were local recurrences after the tumors had been excised, in one case, three weeks, in the second, one month, and in the third, six months after operation. Two of these were fibromyxosarcomata and one a round-cell sarcoma. In this latter case, the recurrence involved not only both breasts, the original tumors having been bilateral, but also the chest wall proper. In one instance, a fibrosarcoma, a tumor had been previously removed, at another institution, from the right breast, and had been reported upon histologically as carcinoma. In another case of fibrosarcoma of the breast, the patient had metastatic nodules in the skin of the back and face. A specimen was excised, the diagnosis was made, and the patient referred for treatment with Coley's fluid. The subsequent history of the patient we have not been able to ascertain.

Of the 18 operated cases, we were able to trace 11. All of the patients but one are alive, the time since operation ranging from four months to nine years. Among them were five fibrosarcomata, upon two of which radical Halstead operations had been performed. The other three were excised locally. The time since operation ranged from one to six years. There were two cystosarcomata, in one of which a Halstead operation had been performed six years ago, in the other an amputation of the breast with removal of axillary glands and fat, four months ago. One case of round-cell sarcoma died of shock following a Halstead operation, a second case, after bilateral local excision, returned in six months with recurrence. Two cases of peritheliomata, for which the

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radical Halstead operation was done two and nine years ago, respectively, are alive and well now. In four other cases a local excision was practised. In two the tumor promptly recurred, in one instance two weeks, in the other, one month, after operation.

We have attempted to group and classify all the reported cases, searching the literature as far back as 1858, when Velpeau's book was published. Many of the papers cannot be utilized because of the absence of clinical or histological data. The following are those available for study.

Including our own cases we have collected, from the literature, 435 sarcomata of the breast. These include practically all types of sarcoma. By far the greatest number were of the spindle-cell type, of which there were 136, or 31 per cent. Next in frequency was the round-cell tumor, of which there were 62, or 14 per cent. It is, of course, rather rare to see either pure round- or spindle-cell types, as in most instances the one or other cell form predominates. Cystosarcoma phylloides followed third, with 54 cases, or 12 per cent. Fourth in frequency was a group classified as adenosarcoma by the older writers, which corresponded to the periductal sarcoma by Greenough and Simmons, which probably represent sarcomatous change in a pre-existing fibro-adenoma. These totalled 26 cases, or 6 per cent. It is probable that some of these periductal fibro-adenomata in their later development become cystosarcoma.

Rarer tumors, as the osteosarcomata reported by Stilling (all of which were fatal), the chondrosarcomata mentioned by Bland Sutton, some of which were also calcareous, are histologically of interest. Another interesting condition is that observed by Legrain in the native women of Algeria, in whom multiple tumors occurred in both breasts, the type being either spindle- or round-cell. These tumors frequently ulcerated and did not metastasize, death, as a rule, resulting from a sepsis following infection of the eroded tumor.

The other types occurred with about equal frequency, though in some of the earlier papers, the nomenclature and classification varied markedly from our present ideas.

*Etiology*—Heredity apparently plays a very small role, Schroeder, in fact, could find no evidence of this relationship. Trauma is noted in about 10 per cent of cases. Occasionally there is a previous history of mastitis. Pregnancy and lactation seem merely to be coincidental, although pre-existing tumors very often show a tendency to a more rapid growth during these periods. Eighty per cent of the women were married and had borne children. In but nine cases was the male breast involved, which would seem to indicate that the physiological activity,

# GEIST AND WILENSKY

	Osteosarcoma	Spindle-cell Sarcoma	Round-cell Sarcoma	Cystosarcoma	Fibrosarcoma	Pleomorphic Sarcoma	Myxosarcoma	Lymphosarcoma	Giant-cell Sarcoma	Chondrosarcoma	Polymorphous-cell Sarcoma	Melanosarcoma	Osteochondrosarcoma	Adenosarcoma	Sarcomatous Degeneration of Fibroma	Cystoid Sarcoma	Langhans-cell Sarcoma	Alveolar Sarcoma	Perithelioma	Unclassified
Greenough and Simmons	3	106	42	14	4	4	5	2	8	2	2	2				11	11	3		4
Stilling	4	3	1	2	3			1	1	1										
Gross		5	3																	
Poulsen (9.3 per cent *)		1	1																	
Horner (8.8 per cent *)		1	3				1													
Rosenstein (5.3 per cent *)		10	4	18			5	1												6
Kausch (7-10 per cent *)							1													11
Funsterer																				
Deaver																				
Powers																				
Kettle (a)		1	1	3	1															
Schreder					2															
Gorham			1																	
Segond and Renaud			1																	
Bland Sutton (b)																				
Speese				1																
Bockenheimer				6																
Beckton (2.3 per cent *)		2	4																	5
Mornard																				
Thompson																				
Boddiaert and Vererullie					1															
Sehrt																				
Vignard		1											8							
Schlagenhauser (c)									1											
Stone (d) (5 per cent *)																				
Deladrier			1																	
Morton (e)										1										
Gebeler (f) (10 per cent *)																				
Hoffmann																				
Manz																				
Schuchardt (g)																				
Schmidt																				
Williams			1																	
Purcell																				
Stanberger		1																		
Tillaux			1	1																
Chambers																				
Pillet																				
Chretien		1																		
de Schweinitz																				
Haslam																				
Bullroth			1																	
Veipeau				1																
Volkman				2																
v Meckle				1																
Authors		5	2	4	5				2										2	
Total	7	136	62	55	17	12	11	5	15	10	9	3	8	26	2	11	11	3	3	29

\* Percentage of sarcoma in breast tumors (a) Carcinoma in same breast (b) With calcification (c) With carcinoma (d) One hundred tumors, no classification (e) With calcification (f) Thirty four cases no classification (g) Male

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or the physiological retrogression, of the female breast has some etiological significance. Most of the tumors seem to arise in breasts that have already functionated, and some represent a malignant change in a previously existing benign tumor. The average age was forty years, but the range extended from four months (Chambers), to eighty-eight years.

*Symptomatology and Course*—Usually the first thing noted is the presence of a small hard mass. The tumor may grow rapidly from this time, or after a period of quiescence may suddenly begin to proliferate. The tumors were, as a rule, single, though they sometimes occurred as multiple masses involving either one or both breasts. Pain is rather infrequent, occurs in about 40 per cent of the cases, and was usually a late symptom. The skin and deep parts were rarely involved. Occasionally the skin was tense and reddened, the cause of which was pressure of the growing tumor. It was rarely adherent and more rarely still was it ulcerated. The tumors varied in size from a walnut to an adult's head.

The nipple was rarely retracted and secretion from the breast was only occasionally present and usually accompanied cystic tumors. Cachexia was rare.

The *histology* of the tumors varied markedly, for not only were all types of sarcoma found, but occasionally carcinoma and sarcoma were found growing side by side as separate tumors, or the stroma of a pre-existing carcinoma was found to be undergoing sarcomatous change.

While the regional lymph-nodes were very often enlarged and palpable, metastatic tumor involvement of these structures was rare. We were able to find records of thirteen cases showing histological involvement of the lymph-nodes, this corresponds to 3 per cent of the total number of cases. In most instances, the lymph-node involvement occurred with the round-cell type of tumor.

*Prognosis*—The cystic types of tumors seem to have the best prognosis. These really represent cystic fibro-adenomata, in which a malignant change has taken place in the stroma. In these cases 75 per cent are cured, even when a local excision is done. In the solid sarcomata, the prognosis is not so good, the mortality in this type being as high as 42 per cent. Tumors of the round- and spindle-cell variety offer the least favorable prognosis. The prognosis, on the whole, is better than in carcinoma, even though metastases and recurrence are fairly frequent.

*Treatment*—The consensus of opinion seems to be that the radical operation is advisable. Local and general recurrences take place, however, even after such extensive procedures. On the other hand, simple

excision has often resulted in permanent cure. The cystic type of tumor and the less cellular spindle and fibrous types lend themselves more to conservative operations. The cellular solid tumors, such as the round- and the giant-cell tumors, are usually very malignant and demand radical operation.

Thirty-seven per cent of the collected cases had local recurrences, 15 per cent had metastases. We were unable to obtain accurate figures on the types of operations performed. The metastases are found in the lungs, liver, brain, dura, retroperitoneal and mediastinal lymph-nodes, axillary and subclavian lymph-nodes, kidney, heart and pleura. In other words, from their location, it would seem that the metastases occurred by way of the blood stream. Poulsen has reported 63 per cent of cured cases, Homer 61 per cent, Goebels, 70 per cent, Finsterer 56 per cent, and our figures, including all collected from the literature, show 63 per cent of cures.

Judging from these results we may say that the prognosis in sarcoma of the breast treated radically is good.

We are indebted to Dr. F. S. Mandlebaum for the privilege of studying the material both from the laboratory and from his private collection. We also thank the attending surgeons, Drs. A. G. Gerster and H. Lilienthal, for the use of the ward histories. For the private records of some of the cases we are indebted to Drs. Brill, Lilienthal, Moschowitz, Berg, Ware and Koles.

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# CARCINOMA OF THE STOMACH \*

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ONE can hardly consider carcinoma of the stomach without first speaking of its most difficult problem, the diagnosis, and especially the early diagnosis. That this problem is of vital interest to the surgeon is evident when we recall

(1) That cases generally come to us in an advanced stage, with a late diagnosis

(2) That the difficulties of early diagnosis are inherent in the insidious nature of the disease

(3) That an early diagnosis is the greatest desideratum in gastric cancer, as on it depends the possibility of successful treatment

(4) That the surgical treatment of early cases gives a low mortality and a satisfactory result

(5) That in many cases the final test of diagnosis must be made by exploration

Most cases in hospital practice come to the surgeon with a late diagnosis, not through the fault of the hospital internist so much as because the patients do not apply for hospital treatment until late, as they regard chronic dyspepsia as a trivial matter or as a necessary affliction to be stoically endured

In looking over hospital records of gastric cancer I have been struck with the number of cases that come into the medical service to die in a short time or to go home as hopeless, without having been seen by the surgeons. This is due to the insidious nature of the disease in many cases. But physicians, and surgeons as well, are not free of all responsibility, as cases of dyspepsia are so apt to be treated by a little diet or some dyspepsia remedy, without anything like a careful examination. We are in urgent need of a propaganda of education of both the patient and the physician, in the matter of chronic dyspepsia and its relation to gastric cancer and ulcer, before we can hope for much better results. The importance of this is emphasized by the fact that gastric cancer is the commonest form of cancer, constituting about 30 per cent of all cases

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## CARCINOMA OF THE STOMACH

I have notes on 36 cases of gastric cancer on which I have operated in the last few years, 30 at or near the pylorus, and 6 at the cardia. These were mostly advanced cases, *i e*, late diagnoses. This series is too small to be of much statistic value, though I have given the percentages in many cases for comparison.

In any series of cases of gastric cancer there are two groups (1) Those that appear to be cancer from the outset (2) Those giving a more or less long gastric history resembling (a) the typical history of ulcer, or (b) an irregular ulcer history. Nineteen of my 30 pyloric cases gave a history of apparently primary cancer, 11 (or 36.6 per cent) of a preceding gastric condition resembling ulcer.

As W. J. Mayo<sup>1</sup> has well expressed it, "The early diagnosis does not depend on any sign or symptom due to the cancer itself, but on the mechanical conditions produced by the growth." In other words, there are no signs or group of symptoms that are pathognomonic of the disease in its early stages. All the symptoms present in the early stages of gastric cancer are common to other ailments of the stomach or alimentary tract, or to several general conditions, such as intestinal tuberculosis, anæmia, chronic nephritis, etc.

Given a patient of over forty years, with persistent symptoms of epigastric pain, vomiting, anorexia, loss of flesh and strength, and anæmia, with a palpable epigastric mass or a sense of resistance, we should be almost sure of the diagnosis of carcinoma of the stomach. This would not be an early diagnosis and in many cases one or more of these symptoms or signs may be absent, rendering the diagnosis more uncertain.

Examining the symptoms more in detail we find that the age limit cannot be definitely fixed. Only 4 of my patients were under 40, the youngest 32, the oldest 72, and the average 53 years.

The pain is commonly not severe, but more a feeling of distress or a dull ache, increased by food and relieved in whole or in part by vomiting. Out of my 30 cases of pyloric carcinoma pain was absent in 4 and very slight in 3 others. It has none of the importance as a pathognomonic symptom that it has in ulcer.

Though vomiting occurs in nearly all cases, 3 of the above 30 cases had none, one vomited once and another but once or twice. Four noticed blood in the vomitus and in four it was coffee-ground. Vomiting may not occur until late in the disease or it may cease toward the end. Gas, causing painful pressure, relieved by regurgitations, is about equal to vomiting in diagnostic value.

Pain, vomiting and gas are not characteristic, for they occur in all



gastric ailments and in many others, but anorexia is more pathognomonic of cancer and serves to distinguish it from ulcer. Only 3 out of the 30 cases retained their appetite. It is lost early and its loss is often the first symptom to attract attention to the stomach.

Progressive loss of flesh and strength is another symptom most suggestive of cancer. Only 2 of the 30 pyloric cases claimed no loss of weight or strength. Twelve stated the amount of weight lost, which varied from 15 to 60 pounds and averaged 40 pounds. All those who had retained their appetite and those who had no vomiting lost much weight, which seems to be independent of the food intake.

Anæmia is another very constant symptom, only one of my cases having a normal percentage of hæmoglobin. It averaged 53.9 per cent in 17 cases in which it was recorded. The skin often has a yellowish hue and is very dry. The facial appearance is often typical and may be of diagnostic value. The pallor and wasting give a pinched wrinkled look about the eyes, nose and mouth and there is a hopeless dejected expression.

A mass, often of considerable size, was palpable in 20 of the 30 pyloric cases (66.6 per cent), and an indefinite sense of a mass in 5 more (16.6 per cent). That a mass does not indicate an inoperable condition, as was formerly supposed, has been shown by all recent reports. Among the 13 cases resected a mass was palpable in 8 (61.5 per cent), and an indefinite mass in 2 others (15.3 per cent). Free mobility of the mass is a cheering sign of operability.

The motility of the stomach may be readily tested by the presence of raisins in the lavage water 12 hours after their ingestion. They are found in over 50 per cent of cases and indicate mechanical obstruction.

These cases as we see them may be diagnosed clinically if, in addition to chronic dyspepsia, as indicated by pain, vomiting and gas, there is persistent loss of flesh and strength with anorexia, anæmia, and the presence of a mass. But these symptoms are neither constant nor do they enable us to make a very early diagnosis.

The gastric analysis and a series of X-ray plates are made in all cases. The absence of free HCl is the rule, but there are not a few exceptions, especially in the group developing on an old ulcer, and it occurs in many general conditions, like anæmia, tuberculosis, chronic nephritis, and syphilis of the stomach. It helps to differentiate cancer from ulcer of the stomach. In the cases where it was recorded 80 per cent had no free HCl. Lactic acid in excess is only found in the absence or low percentage of free HCl and is not present in early cases.

Smithies<sup>2</sup> found the Oppler-Boas bacilli in 93.8 per cent of cases.

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of gastric cancer by the differential agar stain. According to Friedenwald<sup>3</sup> occult blood in the stools occurs in 92.5 per cent of cases.

The glycytryptophan test, that I thought a few years ago was very promising, has disappointed expectations, as it is not infrequently negative in cancer and positive in other conditions. Smithies<sup>2</sup> found it positive in 40 per cent in 141 cases of cancer in the Mayo Clinic.

The Wassermann reaction should be tested in every case in order to help differentiate syphilis of the stomach.

The X-ray is our best ally in confirming or disproving a suspicion of gastric carcinoma. At present our best hope of improvement in the diagnosis of gastric cancer lies in the development of the X-ray. Carman<sup>4</sup> in the Mayo Clinic claims that the X-ray shows diagnostic signs in 93 per cent of the cases of gastric cancer examined. Cole<sup>5</sup> made 96.9 per cent of successful diagnoses by serial roentgenography in 97 cases of various gastric lesions, confirmed by operation. Owing to the expense involved this method cannot be applied as a routine. The average X-ray plates will not give as good results as those obtained by Cole or Carman.

There are numerous tests which are outside the scope of this paper, that we need only mention. Many are useful in differentiating between gastric cancer and ulcer. Among these are Gluzinski's test, recommended by Kocher and thought by Nicholaysen<sup>6</sup> to be the best test of the secretory function of the stomach. It differentiates between ulcer and cancer when there is still some free HCl present. In the presence of achylia or a low free HCl content Smithies<sup>7</sup> found a high percentage of soluble albumin in 78.4 per cent of 215 cases of gastric cancer. In addition the hæmolytic test and the formaldehyde titration index may be mentioned.

None of the tests give uniform results. All may give positive results in a smaller percentage of non-cancerous cases and most of them require an elaborate technic. Most of them are helpful or confirmatory, in connection with clinical symptoms and physical signs, no one or all together can establish the diagnosis alone.

"The diagnosis of cancer of the stomach," says W. J. Mayo,<sup>8</sup> "cannot often be made early enough to obtain a radical cure by operation, but a diagnosis of some condition of a surgical nature, probably cancer, can be made in time to permit operative interference (resection) in more than one third of all cases." The general diagnosis of a surgical gastric condition is far easier than the specific one of cancer of the stomach. The physician should delay as little as possible in convincing himself that medical treatment is ineffective in a given case. The policy of

"watchful waiting" and the use of medical means for a long period in the hope, rarely justified, that the condition may prove benign has sealed the fate of many cases of gastric cancer. In most cases the condition is surgical if not malignant.

Exploration is the final test, and the difficult task of the diagnostician is to decide which of these patients shall submit to it. Exploration must be done early to give the patient a fair chance. To be sure we cannot always distinguish between cancer and indurated ulcer even on exploration. I have had the not uncommon experience of doing gastro-enterostomy for what I thought to be a cancer of the pylorus, giving a bad prognosis, and seeing the patient two and a half years later in perfect health. The condition and its treatment, however, were surgical. In the Utrecht Clinic the result in 21 per cent of the cases of gastro-enterostomy for supposed cancer proved the condition to be indurated ulcer.

In any event the present surgical procedure in both doubtful indurated ulcer and cancer of the pyloric portion is the same, *i e.*, resection. This is due in part to the impossibility of diagnosing with certainty on exploration between pyloric cancer and indurated ulcer, and in part to the danger of carcinoma being engrafted on a chronic ulcer, whether we believe with the Mayo Clinic that it occurs in about 60 per cent of cases, or, with Continental authorities, that it occurs far less frequently.

Hence, given a patient over forty years old, with persistent dyspepsia, without apparent cause and not relieved after a few weeks of medical treatment, accompanied by loss of flesh, strength and color, exploration is to be very seriously considered. This is more imperative if one or more of the various tests or signs are present. In the interest of the patient we must avoid delaying exploration until we are sure of the diagnosis. The X-ray should be employed as a routine in all these cases. It may increase our suspicion or even turn it into certainty. Like all other tests the earlier the case the less certain is the result of the X-ray, and the more skill is required in its use and its interpretation.

The fact must not be lost sight of that what is to be sought for by every means in our power is an early diagnosis. Hence the necessity for an early exploration, which is a relatively safe operation. The risk of exploration is less than the risk of delay. Indiscriminate exploration in advanced cases is to be condemned, especially if no obstruction of the pylorus is present that may be relieved by a palliative operation. These explorations give a considerable mortality, do no good, and discredit gastric operations in general. Of course it is inevitable that not a few

cases are explored that prove worse than they appear to be, and are unsuitable for operation. It is only right to give these patients the benefit of the doubt, if they are fit to undergo exploration. In point of fact, practically every operation on the stomach is to a greater or less extent exploratory at the outset, until the exact condition is exposed and explored.

*Treatment*—There is no curative medical treatment. Resection offers the only cure. Mayo's statistics<sup>10</sup> show that out of 1000 cases of gastric cancer, operated on prior to 1913, 378, or nearly 38 per cent, were resected, and he states that "at least half the cases of cancer of the pyloric end of the stomach may be recognized by our present means of diagnosis early enough to allow the radical operation." These figures are more favorable and encouraging than those of most other clinics.

The ideal and only curative operation in gastric cancer is resection, or partial gastrectomy, which is applicable to cancers at the pyloric end (75 per cent of cases), that are diagnosed early enough. Prolongation of life and relief of distressing symptoms are enough to justify resection in these cases. There is also the prospect of a 5-year cure in about 25 per cent and of a 3-year cure in 38 per cent of the 90 per cent who recover from the operation in the Mayo Clinic.<sup>11</sup>

After opening the abdomen we first determine whether there is any contra-indication to operation on account of metastases in the liver, peritoneum (especially in the pelvis), pancreas or intestines. In the Mayo Clinic the percentage of metastases was 18 per cent. Second, if there are no visible metastases, can the growth be removed? This depends upon the extent of stomach involved, but more especially upon the adhesions or superficial extensions to neighboring organs. Formerly, owing partly to Mikulicz's statement in 1903,<sup>12</sup> that adhesions or superficial extensions to the pancreas increased the mortality from 27.5 to 70 per cent, this condition was considered almost a contra-indication to operation. More recently W. J. Mayo<sup>11</sup> has shown that it does not increase the mortality very greatly, not over 1 per cent, and we now resect many of these cases. Adhesions to the transverse mesocolon must be carefully handled to avoid interfering with the blood supply of the transverse colon. I have peeled the stomach off of the mesocolon successfully in such a condition. In general, adhesions suggest the probability of extension in continuity of the growth, and must be dealt with accordingly. Adhesions when inflammatory do not contra-indicate operation.

If enlarged lymph-nodes are found that cannot all be removed I believe in resection, because it is proved (1) that not all such enlarged

nodes are carcinomatous and (2) that resection gives a longer and more complete relief than gastro-enterostomy, when a complete removal of carcinomatous glands is impossible. In 2 of my cases of resection for cancer the enlarged lymph-nodes removed proved to be simple hyperplasia, on microscopic examination. More than 20 per cent of gastric cancers show no cancerous involvement of the lymph-nodes<sup>13</sup>. Three of Rotgan's<sup>14</sup> cases, where the glands removed were carcinomatous, were alive and free of recurrence over 3 years.

In spite of the lowered percentage of hæmoglobin in most of these cases, resection is surprisingly well borne, for there is very little loss of blood in the operation by the present technic. I have only lost one case among the 13 cases of resection, a mortality of 7.7 per cent. This was due to pneumonia in a patient otherwise doing well, though the hæmoglobin was only 30 per cent. In such anæmic cases we must seriously consider the question of a two-stage operation. We may limit the first stage to the gastro-enterostomy or, better still, if possible, add to this a unilateral exclusion, dividing the stomach as we would in the complete operation. The first operation enables the patient to gain in nutrition and strength, divides the trauma, and so increases the margin of safety. This is particularly applicable to the very poorly nourished and anæmic patients, that are poor surgical risks.

Another means at our disposal in such cases is the direct transfusion of blood. In one case of resection I employed it several days after operation. The transfusion of 1000 c.c. of blood raised the hæmoglobin percentage by one-third and established a convalescence more rapid than usual. It was planned to use it earlier but a donor failed. Another cancer case had 1300 c.c. four days before operation, with a gain of 20 per cent in hæmoglobin. In a case of very indurated pyloric ulcer, with repeated hemorrhages, I used it directly before operation, to render it an operative risk. All these were done by Dr. Lindeman by his method.

The ultimate results in my cases were not so good, owing to the advanced state of the disease at operation. One had merely a polypoid condition at the resected pylorus. After improving for a time he grew weaker, refused food, though he could swallow it, and died in 7 weeks. At autopsy there was found an adenocarcinoma of the cardiac portion, which was not noticed at the operation. Furthermore, he had chronic pulmonary tuberculosis and acute infectious endocarditis. Another, the youngest patient in the series, whose pathological report showed colloid carcinoma on the basis of an old ulcer, extreme vascular changes, and the presence of what seemed to be small gummata, sug-

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gesting a luetic process, was well for 4 months After this there was a recurrence of symptoms and a second operation revealed a peptic jejunal ulcer at the stoma She died soon after, not having the strength *to rally after the second operation* Another patient, who presented a large mass to the right and a little above the umbilicus, adherent in this position to the abdominal wall, died from recurrence within a year

The others had a longer lease of life In one the pathological report of a large tumor was colloid carcinoma, or an extreme example of gastritis polyposa, with excessive degeneration

All were operated by the Billroth II method except one, in which Kocher's modification of the Billroth I method was used In the latter case it was necessary to do a gastrojejunostomy, six weeks later, on account of symptoms indicating obstruction at the outlet of the stomach

There is little to add in the matter of technic I always sever the stomach with the cautery or cauterize the cut surfaces for hæmostasis and to avoid the possible contamination of the wound with cancer cells The Polya-Reichel method, in which the opening in the stomach is sutured into the jejunum to form the gastrojejunostomy, is attractive as it should shorten and simplify the operation

If we cannot do a resection what can we do to palliate? Gastro-enterostomy is commonly done but the results are disappointing, unless there is pyloric obstruction, and a carcinoma at the pylorus not infrequently holds it open instead of stenosing it Even when the pylorus is stenosed the results are disappointing, for there is not a little mortality in these advanced cases, and the sloughing, ulcerating tumor remains in the stomach cavity, hence the appetite does not improve greatly and there is little gain in either weight or strength

I believe that some of these cases offer an excellent field for v Eiselsberg's unilateral exclusion, when the extension and the adhesions of the pyloric tumor are such as to render a safe resection very doubtful Of course it adds somewhat to the length and severity of the operation and can be used only in selected cases v Eiselsberg first proposed his exclusion method for just such cases I employed it in a case about a year ago and the result was more satisfactory than simple gastro-enterostomy The patient lived nine and a half months, though it was an advanced case There was one peculiar result that we had not counted on The disuse of the pylorus as a passageway allowed the tumor to proliferate faster than it ulcerated, so as to tightly close the pylorus The discharge from the ulcerating tumor was thus dammed back and worked out through the abdominal incision, from time to time How-

ever, I think the method worth employing in suitable cases. If the patient improves markedly the attempt at resection in a two-stage operation may later be made.

One of the 10 cases of gastro-enterostomy died two days after operation, of pneumonia, another after 11 days, from progressive weakness, another in 4 weeks, from a perforation of the duodenum, which the tumor had invaded. The others lived a longer time or were lost sight of, but none experienced the relief from the operation that one would expect from analogy with cases of pyloric ulcer. One had a "leather bottle" stomach (limitis plastica), and experienced much relief from the operation. He died one and a half years later with cancerous metastases in the brain.

One case had a gastro-enterostomy done in Philadelphia 5 years before. He was well until shortly before the operation, at which the stoma was found nearly closed by a large adherent tumor. A new stoma was made further to the left. This is interesting as the length of time since the first operation proves that the original condition was an ulcer. The occurrence of cancer after a gastro-enterostomy for ulcer is not common. Paterson says<sup>15</sup> that it occurs in only 1 per cent of cases and uses the fact as an argument against the common occurrence of malignant degeneration of gastric ulcers. In one other case, in which exploration was done, a gastro-enterostomy had been made 7 months before, with relief for 2 months. The time since the operation was here so short that we can draw no similar conclusion as to the character of the lesion.

A form of gastrojejunostomy that I have used in two of these cases, and a few cases of ulcer, where the posterior surface of the stomach was not available on account of adhesions, is the retrocolic short loop anterior gastrojejunostomy. The loop of jejunum is passed through the transverse mesocolon and then through the gastrocolic omentum. It has given good satisfaction.

Jejunostomy was done in one case but the very depleted patient only survived a few days.

Carcinoma of the cardiac end of the stomach has been present in my series of cases 7 times in 36 cases, *i e*, 19.4 per cent. The diagnosis is usually not difficult. In only one case was there no difficulty in swallowing and no obstruction to the passage of the stomach tube. In another case difficulty in swallowing was not complained of, but the passage of the tube was stopped by the growth. All had epigastric pain, often severe, and in two instances radiating to the back. There is usu-

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ally no vomiting, but often regurgitation or gagging after eating, or the food has to be washed down by drinking water frequently. In one case the diagnosis was confirmed by Dr. H. H. Janeway by the use of the œsophagoscope.

No radical operation is at present applicable to these cases. In 5 cases I have done gastrostomy by Senn's or Kader's method, using a No. 22 or 20 (French) catheter. As to the results, the pain may not be greatly influenced, but the nutrition is much improved. After the rest given the œsophagus by the use of the tube for feeding, the patients have almost always found that they could swallow better and thereafter continued to take food partly by the mouth and partly through the tube.

In 7 cases exploration revealed an inoperable condition, hence nothing was done, as there was no indication for gastro-enterostomy. It is most desirable to limit these operations as much as possible. If there are signs of free peritoneal fluid, infiltration of the umbilicus, an evident carcinomatous liver, etc., no operation should be done. The X-ray also may disclose a clearly inoperable condition and contra-indicate exploration.

Prophylactic treatment may be directed toward the precancerous conditions, ulcer and chronic gastritis. This includes the proper medical treatment of both conditions and earlier operation on gastric ulcer, with resection for doubtful indurated ulcers.

In conclusion we may state

1 That an early diagnosis is the great desideratum toward which the efforts of both the internist and the surgeon should be directed.

2 That resection gives excellent results, a low mortality, a fair proportion of complete cures, and a considerable prolongation of life and comfort, when ultimate cure does not result.

3 That some cases may be more safely operated by the two-stage method or after the direct transfusion of blood.

4 That gastro-enterostomy is rather disappointing in its results and its mortality, and that unilateral exclusion offers an improvement in the results.

5 That simple exploration should be restricted as much as possible.

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<sup>8</sup> *Loc cit*

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## LEATHER-BOTTLE STOMACH

WITH REPORT OF A CASE IN WHICH SUBTOTAL GASTRECTOMY WAS DONE

By MILES F PORTER, M D

OF FT WAYNE, IND

Or the more than twenty synonyms for this disease the most frequently seen are—*linitis plastica*, *cirrhosis* of the stomach, chronic interstitial gastritis, and *sclerosis* of the stomach

These terms are used to indicate a pathologic process in the stomach walls which results in a diffuse thickening and hardening, involving a greater or lesser portion or all of the organ, and producing either a diminution or increase, usually the former, in the capacity of the stomach

Brinton proposed as a name for the lesion "*linitis plastica*," on the theory that it was essentially a benign inflammation of the filamentous network of the areolar tissue. He described the disease as insidious, slowly progressive and in the end fatal

Rokitansky, on the other hand, declared the lesion to be fibroid cancer. Since the observations of Brinton and Rokitansky were published, as before, some writers have declared the lesion to be benign and others have declared it to be malignant

That some of the cases reported by Brinton were scirrhus cancers there is no doubt. Lyle's paper is a complete exposition of our knowledge on this subject up to the time of its publication (1911) and includes an abstract of all reported cases up to that time, both benign and malignant, together with the bibliography. His conclusions are as follows

1 "Diffuse fibrosis of the stomach occurs without cancer"

2 "A large number of the cases reported are frankly cancer and have no claim to be termed *linitis plastica*. On the other hand, some of the cases reported as *linitis plastica* are scirrhus cancers. 'This is no doubt true of some of Brinton's cases, for at that period the microscopical examinations were of necessity inadequate'" (Welch, personal communication)

3 "The clinical diagnosis is rarely possible and at the best is always problematic. The microscopical diagnosis necessitates a careful and prolonged search for nests of cancer cells in order to exclude scirrhus"

4 "There is a possibility that the condition may be a precancerous state, bearing somewhat the same relation to scirrhus cancer that gastric ulcer bears to gastric carcinoma"

5 "The treatment is surgical"

KROMPECHER and MAKAI (1912) present a careful study of the subject. They consider the acquired benign hypertrophies of the stomach (sclerotic or leather-bottle stomachs) and the malignant acquired hypertrophies of the pylorus and entire stomach. They sift the question of the occurrence of the benign type, what the criteria are in this as well as in the questionable pylorus hypertrophies, and in which groups of malignant tumors the small-cell scirrhus types are to be placed. A portion of the cases present a definite picture of small-cell scirrhus, another that of an inflammatory nature, in between are groups of cases of thickening and contraction of the whole stomach or the pylorus, the histologic characteristic of which is not yet clear. On the basis of their studies the authors come to the conclusion that even those changes whose explanation is not free from objection must be regarded as cancer of peculiar microscopic structure. The cells of such cancers resemble granulation cells rather closely, and even their arrangement is not that of typical cancer. There are insufficiently differentiated cancers in which, as in basal-cell carcinoma, a marked hyaline transformation of the exuberant connective-tissue is rather to be noted.

Since these insufficiently differentiated cancers are characterized by a disseminated growth which gives them a peculiar characteristic picture, these small-cell scirrhus cases may indeed be designated as disseminated cancers.

A separation of pyloric hypertrophies into benign or malignant is possible and necessary. As to the occurrence of benign inflammatory contraction of the whole stomach they are very skeptical, for they have found only malignant processes in such instances.

BLAND SUTTON (1904) reports three cases and refers to the fact that many cases have been observed wherein the stomach was converted into the semblance of a leather bottle, and in which it was practically impossible to determine whether the lesion was malignant or benign. He says these changes may not be uniform but may be confined to a relatively small area of the stomach. Sutton also calls attention to the frequency with which gastro-enterostomy for supposed inoperable gastric carcinoma is followed by complete recovery.

CURTIS reported a case of linitis plastica benign, but because of protests against this diagnosis went over the sections again and found a small area which was cancerous.

JABOULAY did a total gastrectomy for this condition and one year later removed the rectum of this same patient for a similar lesion. On the other hand, Lyle and others have reported cases of leather-bottle stomach which recovered after posterior gastrojejunostomy. Lyle's case was living three years after operation.

SHELDON reports a case in which he did a gastro-enterostomy and the patient eight years after was in perfect health. He says that benign diffuse sclerosis of the stomach does occur but is a rare condition, that it is possible that a carcinomatous process may develop in a stomach already the seat of chronic sclerosis, but that it is improbable that such a case has been reported.

BRET and PAVIOR report a case of sclerosis of the stomach in which no evidence

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of malignancy could be found in the stomach wall, but the perigastric glands were cancerous. Johnson reports a case in which he did a posterior gastro-enterostomy and the patient made a practically perfect symptomatic recovery. The dates are not given in Johnson's report but it seems to have been made soon after the operation. George Woolsey, in discussing Johnson's report, said he had had a similar case in which improvement followed gastro-enterostomy but the patient died within two years thereafter from carcinoma of the stomach.

MOYNIHAN reports a case in which he did a complete gastrectomy for leather-bottle stomach. The lesion in this case was proven to be an atrophic scirrhus with extensive fibrous hyperplasia of the submucous coat. The patient recovered from the operation and remained well for three years when he began to fail and died four months later of anæmia. An autopsy showed no malignancy anywhere in the abdomen.

RORSON recognizes a benign and a malignant type of cirrhosis of the stomach and points out that the course of the benign type is much slower than that of the malignant type.

W. J. MAHO says they have had in their clinic "perhaps twenty cases of so-called leather-bottle stomach, and all those they have been able to excise and make sections of proved to be malignant, although sometimes many sections had to be cut before a malignant area was found."

KROMPECHER's opinion is that the disease is not a mere disease of the pylorus but may and does sometimes involve the intestines and peritoneum and is the result of cardiac insufficiency and arteriosclerosis.

That similar changes to those occurring in the stomach in leather-bottle stomach also occur in both the large and the small bowel is proven by several reported cases. The pathologic findings in some of Krompecher's cases seem to bear out his contention that the sclerosis is the result of cardiac and vessel changes. In Lyle's case also there was cardiac insufficiency. One is reminded here of the relationship supposed by some to exist between fibromata of the uterus and cardiovascular changes. Lyle says that in going over Fenwick's cases he was impressed with the likeness they presented to "the lesions of severe anæmia." It will be recalled here that Moynihan's case above reported died of anæmia with no signs of a return of the sclerosis. The writer has succeeded in collecting the reports of 67 cases, including both the malignant and the benign, in which the duration of symptoms is given, and finds that out of 10 malignant cases there were 3 that had complained two months or less. In 5 benign cases there was but 1 that had complained less than two months. (In this case the duration of symptoms is given as one month.) The average duration of symptoms in 39 benign cases was 41.1 months. In 28 malignant cases the average duration of symptoms was 18.9 months. These figures do not include my own case.

The disease is more common in men than in women and is essen-

trially a disease of adult life. It is interesting and important to note as bearing upon the question of malignancy, that the age incidence is practically the same in the group reported malignant as in that reported benign. This adds weight to the argument that some and perhaps many of the cases reported as benign were really malignant. Ulceration is rare but peritonitis, as evidenced by adhesions, etc., is common. It is well to recall here that Viellers has reported two typical benign cases complicated with tuberculosis and says this complication is common. The characteristic pathologic change is a thickening and hardening of the walls of the stomach which usually results in a decided diminution of the size of the cavity, but in rare cases there may be dilatation. There are no distinctive symptoms of linitis plastica. The diagnosis has been made before operation or autopsy but three times (Boulton 1862, Deguy 1896, Osler 1901). Moynihan, however, when showing his case to the class before operating, mentioned the possibility of its being one of leather-bottle stomach. It would seem, however, that if one had in mind the condition, the diagnosis might be much oftener made. A skiagram of a leather-bottle stomach filled with bismuth would, it seems, often be very significant if not diagnostic, as it was in Moynihan's case.

Filling of the stomach with gas, air or water should be of diagnostic value in many cases. The size, location and direction of a tumor when present might be suggestive. In Lyle's collection of cases a "sausage-shaped tumor or a sense of resistance was reported in 13 cases." Given a case in which sclerosis of the stomach is suspected, a coexisting arteriosclerosis with cardiac trouble would add to the suspicion. A clinical diagnosis between a benign and a malignant leather-bottle stomach is impossible. Indeed, as shown in the earlier part of this paper, it is often necessary to make numerous sections before the question of malignancy can be decided.

Unless relieved by surgical means the disease is invariably fatal. In the present state of our knowledge the conclusion seems warranted that the treatment of this condition should be gastrectomy in all cases in which this operation is at all feasible.

The following case occurred in the writer's practice.

J J, aged forty-six, white, male, married, glass worker. Was admitted to Hope Hospital April 11, 1914, having been referred by Dr. Dodds, of Hartford City, to Dr. G. W. McCaskey, who in turn referred the case to me.

Complaint. Stomach trouble. Family history. Father died at sixty-seven of pneumonia. Mother died of lung fever. Three

brothers and three sisters living and well Pateinal uncle had cancer of the nose Previous history Always been strong and healthy Never been ill before Denies venereal infection Has eight children living and well Uses neither alcohol nor tobacco Has always been a hard worker and light eater Eats everything but rather irregularly Keeps his bowels moving regularly daily by taking physic

Present illness Began about five weeks ago with pain in left side low down, which seemed to "work up" until now it is localized just under the navel Patient says he feels as though there were a heavy cake there Stomach has a gnawing and grinding pain which gets worse about 7 or 8 o'clock P.M. Eats his supper at about 5 o'clock Noon meal seems to have no influence on the pain Everything the patient eats seems to sour He belches a great deal and is troubled with gas At night when the pain comes on he is nauseated Has not lost weight Rests well at night until early morning when he awakes and gets restless No nocturia No headache Has dyspnoea when pain comes on and on exertion

*Physical Examination*—Heart normal except for slight accentuation of the second sound Large growth in the epigastrium extending down as far as the umbilicus and three inches to the left The margin of this tumor is very definite to the left and rather indefinite to the right Tumor is tender on pressure Very slight and doubtful respiratory movement The upper border of the tumor extends under left costal margin at about the centre Urine normal Blood hæmoglobin 75 per cent, white blood-cells 7600, pn 65, s 10, L 1, eosinophil 1 Gastric contents coffee-ground in appearance, much mucus, blood, hydrochloric acid 4 per cent, total 40, Oppler-Boas bacilli and sarcinae present Stools contained no mucus nor blood Diagnosis Gastric cancer

*Operation* (April 16, 1914)—Ether anaesthesia Through a midline incision, it was found that practically the whole stomach was involved in the tumor No glandular involvement was discovered The under surface of liver was adherent to the pyloric end of the stomach over an area about the size of a small palm (it was later found that this area of adhesion corresponded with the ulcerated area on the mucous surface of the stomach) A subtotal gastrectomy was done After closure of the duodenum a loop of the jejunum was brought up and united to the remains of the stomach with the aid of a Murphy button reinforced by a few Lembert sutures of linen The Murphy button was used because there was not enough stomach wall left for the gastro-enterostomy by suture unless the union between the stomach and

gut was made in the vertical direction and it was feared that this would produce too much tension. The man was allowed fluids in small quantities on the day following the operation. He made an uninterrupted recovery and was discharged from the hospital May 7 (21 days after operation). The Murphy button was recovered on the sixteenth day. The relief following the operation was pronounced and satisfactory, and the man continued free from symptoms for some time. Later, however, he began to fail and developed a tumor in the epigastric region. He died September 6, having lived six months and ten days after the operation. No autopsy was made.

The accompanying illustration (Fig 1) shows the extent of the resection. Fig 2 was made from a photograph of the specimen (preserved in formalin). The pathologic process involved the whole of the stomach except the fundus. The walls of the stomach were universally thickened and firm, and cut almost like cartilage. On the mucous surface were several ulcers in the

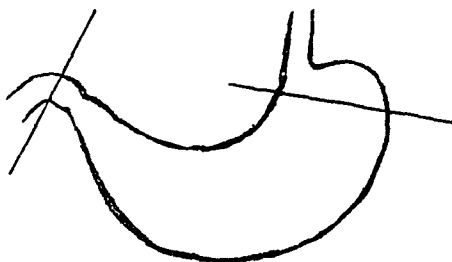


FIG 1—All that portion of the stomach including the pylorus between the two straight lines was removed. The remaining portion of the stomach after closure served to lengthen the oesophagus making the anastomosis with the jejunum very easy of accomplishment.

pyloric region, one quite large extending nearly or quite to the peritoneal covering on the anterior wall. It was over this area that the left lobe of the liver was adherent. The capacity of the organ was diminished. Fig 3 is a photomicrograph of a section of the stomach wall adjacent to the large ulcer, and shows the presence of masses of carcinomatous cells. Fig 4 is a photomicrograph of a section at the edge of the large ulcer, showing first the transformation of the epithelial cells lining the gland lumina from the benign to the malignant type and, second, the marked surrounding inflammatory infiltration.

The points of particular interest in this case as they appear to me are

(1) The rapidity of the process. This patient regarded himself as a well man five weeks before the operation, at which time practically the whole stomach was involved, as the illustration shows. He lived



FIG. 2 —Photograph of the specimen after it had been in formalin solution for a number of weeks. Note the great thickening of the stomach walls throughout except near the points of section. There is one large deeply excavated ulcer at A, another ulcer not so large or deep at B and between the two several ulcerated areas. Perforation at the base of the large ulcer was prevented by adhesion to the right lobe of the liver. In the centre of the base may be noted the area from which the tissue was removed for microscopic section. The incision for opening the specimen was made through the posterior wall.



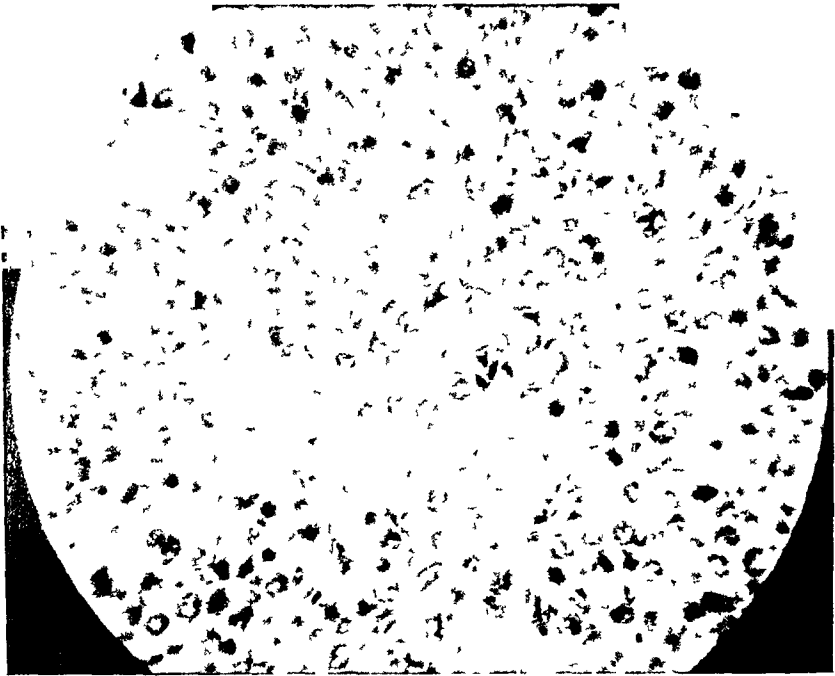


FIG 3 —Photomicrograph of section of stomach wall adjacent to the large ulcer Note masses of carcinomatous cells

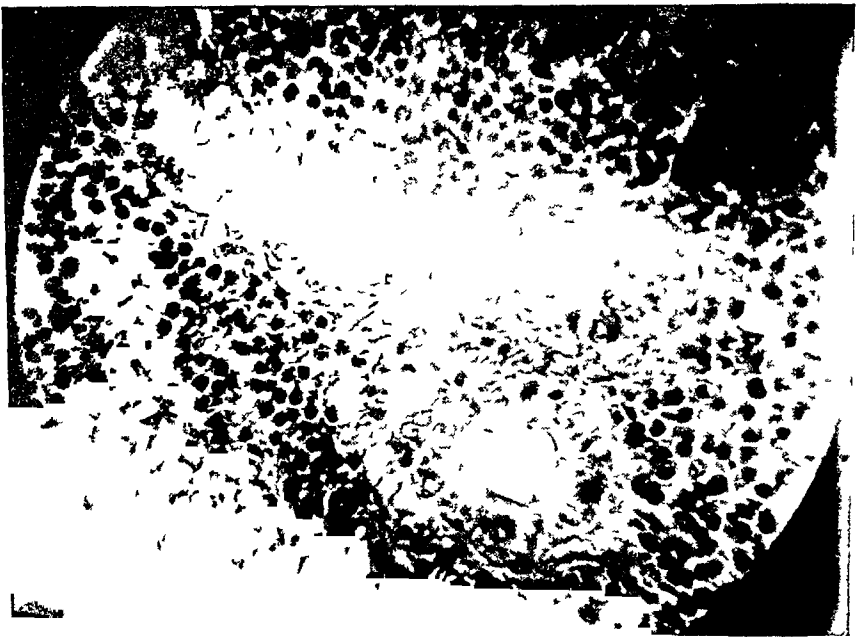


FIG 4 —Photomicrograph of section from edge of ulcer Note transformation of cells lining the gland lumen and surrounding inflammatory infiltration

## LEATHER-BOTTLE STOMACH

but seven months and fifteen days from the onset of the symptoms, notwithstanding the complete though temporary relief from the gastrectomy

(2) The patient suffered some from dyspnoea on exertion and there was some accentuation of the second sound of the heart. There was also some anæmia. These clinical findings are in accord with Krompecher's theory that the stomach changes are due to cardiovascular disease.

(3) The absence of glandular involvement, and the relative absence of adhesions. After the stomach was separated from the liver, which was done without difficulty, the operation was as free from difficulties as could be.

(4) To me the Murphy button seemed admirably adapted to the making of the anastomosis in this case and the result sustains this opinion.

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## CANCER OF THE TESTIS \*

CONTAINING A REPORT OF 64 CASES, WITH SPECIAL REFERENCE TO 12 CASES OF CANCER OF  
THE UNDESCENDED TESTIS

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WHETHER the undescended testicle is more liable to be the seat of malignant disease than the normally descended testicle, is a question that has never been fully settled. The opinion generally held is that the undescended testicle is much more likely to become malignant than the normally descended testicle. The most comprehensive study of this question in recent times is that of Dr. Kenneth Bulkley of New York, on "Malignant Disease of the Testicle Retained Within the Abdominal Cavity" (*Surgery, Gynecology and Obstetrics*, vol. 17). Literature on this subject is exceedingly meagre.

Blanck's collection in 1906 showed only 19 cases of malignant tumors of the testicle, but Bulkley has collected 57 cases from the literature, and to this he has added 2 hitherto unreported cases from the Presbyterian Hospital of New York, making a total of 59 cases of sarcoma of the abdominal variety of ectopia.

Bulkley states that for years it has seemed to be a surgical superstition that the testicle retained within the abdominal cavity is prone to undergo malignant degeneration. Many of the older writers, Dupuytren, Arnot, Gowers, Lecompte, Godard, and Spry, had called attention to it before Johnson in 1859 put the first case on record. Godard, however, records a very remarkable personal experience, stating that he has observed 8 monorchids suffering from sarcoma, in 7 of which the disease had occurred in the undescended testicle, and in the eighth, in the normally descended testicle. He gives, however, no detailed report of the cases.

Bulkley found no cases reported prior to 1859, and only 57 since that time in the medical literature of France, Germany, Russia, Italy, and the English-speaking races. He attempts to estimate the relative frequency of the condition from the various statistics, and quotes Eccles' analysis of 60,000 male admissions to The London Hospital,

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\* Read before the Southern Surgical and Gynecological Association, December 15, 1914.

showing 38 cases of sarcoma of the testis, of which, one occurred in the undescended testicle

Howard found in 110,000 male patients admitted to various London hospitals during a period of twenty years, 65 cases of malignant disease of the testis, of which 9 occurred in the ectopic testicle, all of the inguinal variety, and none of the abdominal. Bulkley adds new data derived from a record of 12,729 consecutive male admissions to the Presbyterian Hospital of New York, giving 13 examples of malignant tumor of the testis, of which 11 were situated in the scrotum, and 2 in the abdomen. Combining these statistics we find that of 182,729 male admissions to general hospitals, there were 116 cases of sarcoma of the testicle, of which 12 occurred in the undescended testicle, only 3 of these occurring in the intra-abdominal testicles, or about one in each 60,000 cases.

At the Hospital for Ruptured and Crippled, from 1890-1907, in 59,235 cases of inguinal hernia in the male sex there were found 737 cases of undescended testis, without a single case of sarcoma of the undescended testis. However, it should be noted that the statistics of the Hospital for Ruptured and Crippled, or of any large hernia clinic, do not give a fair estimate of the relative proportion of cases of sarcoma of the undescended testicle, inasmuch as many of these cases, particularly those of abdominal ectopia, will seek relief at some general hospital rather than go to a hospital devoted specially to the treatment of hernia. My own personal statistics throw, perhaps, some further light upon this question. During the past twenty-five years, I have personally observed 65 cases of sarcoma of the testicle. The first 25 of these cases occurred in the normally descended testicle, in the next two cases, however, the disease occurred in the undescended testicle. On going over my entire statistics I find that in 52 cases the disease occurred in the normally descended testicle and in 12 cases, in the undescended testicle.

Different writers give different opinions as to the relative frequency of cancer of the normally descended and mal-descended testes. Shoedel encountered 5 cases of cancer of the inguinal testicle compared with 36 cases of cancer of the normally placed organ, Odiorne and Simmons, in a review of 54 cases of malignant disease of the testicle observed at the Massachusetts General Hospital, found 6 or 11 per cent in which the disease occurred in the undescended testes, of these, 4 were in the abdominal cavity, and 2 in the inguinal canal. Rademacher gives the proportion of malignant abdominal to malignant inguinal testicle, as 1 to 8. Meiser found 64 malignant inguinal as against 4

abdominal testes Bulkley, himself, however, found at the Presbyterian Hospital 2 cases of malignant abdominal in 12 cases of malignant inguinal testes An analysis of these cases encountered by Chevassu, Odiorne and Simmons, and the Presbyterian Hospital records, show the proportion as 1 to 5 My own statistics show almost the same proportion 12 undescended in a total of 64 cases of sarcoma of the testis, or about 1-5½

The influence of trauma upon the development of sarcoma of the undescended testicle is less clear than in the case of the normally descended testicle Bulkley states that only 2 cases of the abdominal type gave a history of direct trauma He mentions the possibility of trauma from the contraction of the abdominal muscles as a factor in those cases in which the testicle lies at, or near, the internal ring

As regards the age of development, 42 or a little over 75 per cent occurred between the ages of twenty-five and forty-five years This shows that the age of development of sarcoma of the normally descended testicle is practically the same as that of the undescended testicle as shown by Kober, who found that 71 per cent of 114 cases of scrotal sarcoma of the testis occurred between the ages of 20 and 50 years

As to the pathology of Bulkley's 59 collected cases,

- 20 were classed as sarcoma
- 10 were classed as round-celled sarcoma
- 6 were classed as large round-celled sarcoma
- 1 was classed as spindle-celled sarcoma
- 1 was classed as mixed sarcoma
- 1 was classed as myxosarcoma
- 1 was classed as cystic sarcoma
- 2 were classed as teratoma
- 2 were classed as epithelioma
- 2 were classed as chorio-epithelioma
- 7 were classed as carcinoma
- 1 was classed as rhabdomyoma
- 5 were classed as cancer

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*The Clinical Diagnosis of Cancer of the Undescended Testis—*  
If the testis is in the inguinal canal, or inside or just outside of the ring, it is possible to make a fairly early diagnosis, the signs or symptoms being not unlike those found in connection with sarcoma of the normally descended testicle If, however, the testis is situated in the abdominal cavity, the diagnosis is rarely made until the disease has reached a fairly advanced stage Acute abdominal pain is often the

earliest symptom Usually there is a history of dull, dragging pain in, or over, the iliac fossa If the trouble is on the right side it is not infrequently mistaken for appendicitis In several cases I have known operation to have been performed in the belief that the condition was that of appendicitis After a few weeks—in some cases months—these irregular symptoms are usually followed by the appearance of smooth, ovoid or round tumor in the lower iliac fossa, more or less tender on pressure In some cases slight fever accompanies the condition, the temperature is usually normal Sometimes the condition becomes so far advanced before a diagnosis is made, that marked swelling of the leg occurs, accompanied by severe lumbar pain Bulkley's statistics show 4 cases of strangulation with twisted pedicle to have taken place, in all of which there was an acute onset with abdominal pain, fever, nausea, vomiting, and objective signs of an acute abdominal lesion In most cases the tumor is fairly well fixed and not very movable

Furthermore, Bulkley found only 9 cases in which the presence or absence of offspring was definitely noted Five of these were single cryptorchids, and were fathers of children, four had no children, only one of the latter being a double cryptorchid Bulkley states that not a single case of double cryptorchid with malignant testicle has as yet been reported as having offspring This statement will have to be modified since the publication of McGlannon's paper, read before the Southern Surgical and Gynecological Association, at Atlanta, Ga., December, 1913

*Differential Diagnosis*—The first and most important step in the diagnosis is a careful examination of the scrotum with a view to determining the presence or absence of a normally descended testicle This, however, has been omitted in many of the recorded cases Before the disease has advanced sufficiently to form a palpable mass, it may be very difficult to make a diagnosis, as the condition cannot be easily differentiated from that of renal colic, appendicitis, or cæcal tumors If the testes cannot be found either in the scrotum or inguinal canal, and a tender mass is felt in the lower iliac fossa, giving rise to the symptoms already mentioned, the chances are very strong that one is dealing with a malignant ectopic testicle

Tuberculosis of the abdominal testis is remarkably rare, as is likewise acute inflammation of the abdominal testicle

There have been found a few cases of abdominal orchitis of gonorrhœal origin, but no case of syphilitic abdominal orchitis has as yet been reported

*Prognosis*—The prognosis in these cases is exceedingly bad, due

apparently to the fact that an early diagnosis is at present seldom made. In five cases the nature of the condition was not recognized until an autopsy was performed.

The results in Bulkley's 59 collected cases show the gravity of the condition. In 37 cases excision was done, with an operative mortality of 10 per cent. Of the remaining 22 cases, 18 only were traced. Seven cases remained well, but in the majority of these, the interval of time which elapsed between the operation and the date of report is much too short to draw any conclusions as to a permanent cure. Only one patient out of the 37 was well over three years, and but three remained well over two years.

The question of prophylactic treatment is an important one, inasmuch as it may mean the removal of a testis before a malignant growth has occurred. Bulkley believes, that from present statistics we can roughly state that one in every 75 abdominal testes will become malignant. In his opinion, if the individual has one testicle in the scrotum, the abdominal testis should, after puberty, be removed. He states that 37 of the collected cases were single cryptorchids developing malignancy in the abdominal testicle, and that all would have been saved had an abdominal orchidectomy been done before the onset of malignancy, that is, shortly after puberty. In the case of a double abdominal cryptorchid, operation would not be advisable except in the presence of objective signs.

Bulkley's argument is based upon the assumption which he believes to have been proven by statistics, that one in every 75 abdominal testes will become malignant. Personally I do not believe that we have sufficient data at present to warrant us in accepting this estimate. I believe it is much too high. Inasmuch as the condition is usually associated with a hernia, I believe it justifiable to operate, and only in those cases in which it is found impossible to bring the testicle down into the scrotum, would I sacrifice the testicle. My series of cases shows that the trauma incident to the operation of bringing down the testis into the scrotum, may have been the exciting cause of the sarcoma in at least one case.

Bilateral sarcoma of the undescended testes is exceedingly rare. Bulkley's collection of 59 cases shows only two examples, to which has been added one case by Dr. Oliver C. Smith of Hartford, Conn. (*Boston Medical and Surgical Journal*, May 28, 1914, page 839, vol. clxx). A careful search of the literature by Dr. Smith failed to find any other cases.

A brief history of his case is as follows:

## CANCER OF THE TESTIS

Male, aged thirty-eight, farmer, white, married, no children Both testes absent since birth Eight years previous, patient had suffered from painful swellings in both inguinal canals, following an attack of mumps Two months before operation he noticed enlargement in both inguinal canals, followed by rapid growth and considerable pain on one side

*Physical examination*, at the time of operation, July 10, 1913, showed both iliac fossæ and inguinal canals occupied by large fluctuant tumors, the right extending from the upper margin of the scrotum to above the umbilical line The tumor upon the left side occupied the inguinal canal and was less tense Both testes were absent from the scrotum Operation revealed an enormous fusiform cyst of the tunica vaginalis, containing 75 cc of clear straw-colored fluid In the upper portion was a hard, irregular mass The tissues of the cord, including the vessels and lymphatics, were dissected beyond the internal ring the vas deferens was followed as far down as possible toward the pelvis and removed A similar operation was performed on the left side, at which time about half the amount of fluid as was found on the right side was removed, together with a malignant testicular tumor The operation was followed by but little reaction, and primary union resulted The pathological report made by Dr John Carter Rowley (pathologist at the Hartford Hospital) read "Large, round-celled sarcoma of each organ"

Recurrence followed in 8 months and death shortly afterward

I have another case to add which will be found in my report of cases

*The Duration of Life in Cancer of the Testis (Scrotal Cases)* — Cancer of the testis must be looked upon as a particularly malignant type of cancer and the course of the disease is considerably shorter than in most other types My own series of cases shows that in 48 of the fatal cases in 29 the duration of life was one year or less In every one of the 6 cases in which it was over three years, the toxins had been used In one case of five years' duration, it was stated that the tumor had existed four years before operation In this case it is possible that the tumor was not malignant during the entire period, but a malignant degeneration occurred in an older and originally benign process

The duration of life in cancer of the undescended testis is worthy of special note, it being much shorter than in the ordinary scrotal type, varying from 3 months to 8 years In 7 of the 12 cases death occurred within less than one year from the beginning of the first symptom Only 3 cases lived over 3 years, one 3½, one 6, and one 8 years, and in all of the latter the mixed toxins were used after operation

Chevassu's statistics show the duration of life in fatal cases to be as follows

Unknown in	15 cases
15 days to 1 year	38 cases
1 to 2 years	17 cases
2 to 3 years	9 cases
3 to 4 years	2 cases



In other words, death occurred before three years in nearly all of the cases, and in 74 per cent death occurred one year after operation

Chevassu in an important paper on The Surgical Treatment of Cancers of the Testicle (*Rev de Chin*, vol 41, 1910) has made the first attempt along scientific lines to ascertain the actual results following the surgical treatment of cancer of the testicle Beginning in 1894 he gradually collected a statistic based only upon tumors of the testicle in which the same histological examination was practised, and in 1908 he published an elaborate paper on Cancer of the Testicle (*Theses de Paris*) in which he reported 85 cases His later work (*loc cit Rev de Chin*) contained 100 cases

Chevassu calls attention to the extremely pessimistic views as to the curability of cancer of the testis, expressed by classical writers, and still held by the great majority of modern surgical authorities, *e g*

Reclus (Duplay and Reclus, 2nd edition, T VII, 1899), who states that malignant tumors of the testicles are not only fatal, but are so rapidly fatal that one almost always asks the question if operation may not hasten generalization

Sebileau (Le Dentu et Delbet, T 10, 1901, p 241) "Notwithstanding one hastens to perform castration, it seems almost always too late, inasmuch as a recurrence, and an apparently rapid one, uniformly follows"

Arrou (Richard et Rochard, *Chin de l'appareil genital de l'homme*, 1901, p 239) "Castration has never cured an individual suffering from cancer of the testicle"

Monod and Terrillon (*Traite des maladies du testicle*, 1889, p 619) "Castration does not give any general hope of life to patients operated upon"

Other well-known authorities such as, Paget, Curling, Kocher, Le Dentu, Duplay, Most, Chalot, etc, might be quoted to confirm the same opinion Chevassu states that they all admit the constancy of recurrence, and, in regard to the few examples of cure that have been published, they regard it is so exceptional as to make it possible to question the exactness of the diagnosis Pousson (*Gaz hebdomadaire de Bordeaux*, September 12, 1909) expresses an even more pessimistic opinion as to the hopeless prognosis of tumors of the testicle He states "Sarcoma may sometimes be cured, but epithelioma, never For my part, I have never seen a cure I consider an attempt to remove the abdominal glands as useless I do not believe that the search for the glands in any way improves the results"

American authorities, *e g*, Dr Bevan (*Keen's System of Surgery*) who expresses the same opinion, and states that he has never seen a cure, no matter how early operations were performed

Chevassu's statistics, based upon 100 cases, very carefully collected and analyzed, prove that these gloomy views are not in entire accord with the actual facts The operative prognosis of cancer of the testicle, while still very grave, is not as bad as it has been pictured Instead of an occasional patient surviving operation, and thus being explained as a mistake in the diagnosis

## CANCER OF THE TESTIS

Chevassu shows that in 100 cases, in which there can be no question as to the diagnosis of malignancy, 19 patients were found alive and well from 4 to 10 years after operation. A study of the histological type of these cases of survival is of great interest. He classes them as follows:

Of 47 cases described as "epithelioma seminal" 16 were cured, that is, well from 4 to 10 years.

Of 50 cases classed as "mixed tumors" only three were cured.

Of the 3 remaining cases classed as "sarcoma" all died.

The more one studies the recent attempts of the pathologists to classify malignant tumors of the testicle into a large number of distinct groups, the more futile seem such attempts, inasmuch as each one of the many types depends upon the histological character and arrangement of the cells, which is differently interpreted by nearly every observer. For example, take the two most recent, and by far most important, contributions to the study of tumors of the testicle, published by Chevassu (*loc cit*) and Ewing ("Teratoma of the Testis, and Its Derivatives," *Surgery, Gynecology, and Obstetrics*, March, 1911).

Ewing believes that practically all cases of malignant tumor of the testicle should be classified as teratomas, or carcinomas derived from teratomas.

Of the 100 cases of Chevassu, he classes only one as a teratoma. He classifies his cases thus, as: 1 Epithelioma seminal or seminoma, 47 cases; 2 Sarcoma (rare), 3 cases; 3 Mixed tumors, 50 cases. As regards his group of so-called "mixed tumors," 50 out of a total of 100, he subdivides them as follows:

(1) Teratomas, or tumors benign.

(2) Tumors properly called "mixed tumors," polymorphomes, or heteromorphomes. These tumors are originally benign, but later assume a tendency to degeneration.

(3) Epitheliomas, sarcomas, placentomes, etc., in which one no longer finds remains or mixed tumors (cartilage, muscles, etc.) but which have absolutely the same structures as certain malignant degeneration of malignant mixed tumors.

In regard to teratomas, Chevassu states that they are usually benign, but susceptible to malignant degeneration. Of 6 teratomas, in which he followed up the after history, only one presented microscopical manifestations of degeneration, and this alone proved fatal.

Ewing in his paper presents a very lucid and exhaustive study of tumors of the testis, particularly bearing upon the etiology of such tumors. He calls attention to the fact that the formerly extensive group of sarcomas has been narrowed by the elimination of many cases of carcinoma which were once regarded as alveolar sarcoma.

Ewing advances the view that practically all malignant tumors of the testicle originate from a pre-existing teratoma, and he takes issue with Chevassu, who believes that his class designated as "seminoma" originate from the epithelial cells of the seminal tubules and are entirely unrelated to teratoma.

I have neither the requisite knowledge, nor is this the proper place to discuss the relative merits of these opposing theories. I wish merely to point out that before entirely accepting Ewing's conclusions much additional evidence must be offered. The most important objection to this theory is, that in a very large number of cases of cancer of the testicle no teratomatous elements are found. Ewing explains the absence of these elements by assuming that a preexisting teratoma at the time of operation had already been destroyed by the advancing carcinoma. This is a very broad assumption and comes dangerously near "begging the question."

I still consider it the wiser plan to make a separate group of those tumors which show typical histological characteristics of teratoma, as Chevassu and Wilms have done. This group of tumors will be found to present markedly different clinical features from the larger group of tumors, which have been almost universally designated as sarcoma by the older pathologists, but more recently have been classed as carcinoma or mixed tumors. This larger group of cases—exclusive of the teratomas proper—have a very similar clinical history, and in harmony with that of carcinoma tumors rather than sarcoma. Hence, I believe that the old idea of classing them all as sarcoma was probably an error. Like carcinoma, they have a strong tendency to involve the neighboring lymphatic glands, and again, like carcinoma, they are much less strongly influenced by the mixed toxins of erysipelas and bacillus prodigiosus than sarcoma.

Is it not possible to assume that a preexisting teratoma may play a secondary and minor part in the etiology of malignant tumors of the testis, such as the dermoid cysts play in malignant disease of the ovary, or as chronic mastitis or benign adenomas play in the development of cancer of the breast? They simply offer a point of least resistance or a favorable soil for the development of the disease. No matter what views we may hold as to the etiology of these tumors of the testis, the wide difference of opinion as to their classification, that exists among pathologists at present, furnishes a very good reason for reverting to the old and comprehensive term "cancer," which includes all varieties of malignant tumors. This was evidently the opinion of Chevassu, for he groups all his cases as "cancer of the testicle."

In 1901 (*ANNALS OF SURGERY*, September, 1901) Dr. B. H. Buxton and I reported before the New York Surgical Society a very typical case of teratoma of the testicle, in which a very careful microscopical study was made by Dr. Buxton. In this report we stated

"Wilms's paper (*Beitrage zur Pathologischen Anatomie*, Ziegler, Band 313) is undoubtedly the most complete and valuable work we have upon teratoid tumors of the testis, but we must remember that it was written entirely from the point of view of the pathologist

The material upon which his paper is based comprises ten tumors of the testis observed by himself at the Pathological Institute of Giessen, and which he classes as "*Mischgeschwülste des Hoden*," and fifteen others, classed as dermoid cysts, that he has collected from literature To show the confusion that has existed up to the present time, and still exists, as to the classification of these tumors, we need only to note that the original microscopical diagnosis in the ten cases which he classes as teratoid tumors was as follows

The first case was classed as a myxosarcoma,  
 The second as a cystosarcoma,  
 The third as a carcinoma,  
 The fourth, mixed tumor of the testis,  
 The fifth, carcinoma,  
 The sixth, medullary carcinoma,  
 The seventh, cystoma,  
 The eighth, cystoid disease of the testis,  
 The ninth, cystosarcoma of the testis,  
 The tenth, teratoma, with malignant degeneration

I do not think we should adhere too literally to the view of the pathologist, that these teratoid tumors are non-malignant In two of Wilms's ten cases the subsequent history proved them to have been malignant, and in several of the remainder the after-history was not traced"

*The Prognosis of Cancer of the Testicle*—The prognosis of sarcoma of the undescended testis, as I have already stated, is exceedingly grave Bulkley's entire series of 57 cases of sarcoma of the testis, shows only one in which the patient remained well over three years My own series of 11 cases shows two patients living beyond three years

The nearest approach to a cure has been my case, D1 B, in which a very extensive tumor was removed by Dr J B Murphy, who sent him to me immediately after he had recovered from the operation, for prophylactic treatment with the toxins When he reached me there was already marked induration in the iliac fossa and abdominal wall, whether due to a recurrence or an inflammatory condition resulting from the operation, it is impossible to state At any rate, the induration disappeared under the toxin treatment and the patient remained well for three years, and then died of a probable recurrence in the lung, but it is not entirely certain, as he had been suffering from tuberculosis of the lungs for some time before he developed the sarcoma of the testis

Of my other cases of cancer of the undescended testis, one of the inguino-superficial type, operated upon by Dr Howard Lilienthal, and treated by him with the mixed toxins of erysipelas and bacillus prodigiosus, under my direction for several months, is still well six years thereafter

Until recently few statistics have been available upon which to base any very definite conclusions as to the actual prognosis of sarcoma of the testicle. The most important recent statistics are found in the papers of Kober,<sup>1</sup> Chevassu,<sup>2</sup> and Codman.<sup>3</sup>

Of 114 cases collected by Kober, which were treated by operation, 37 were not traced. Of the remaining 77, 41 died in from a few days to three years. Of these 41 fatal cases, 23, or 56 per cent, died within five months, of metastases. Eleven others died from seven to twelve months after operation, making 83 per cent of the fatal cases that died within the first twelve months after operation. Two patients lived beyond three years, but died later of recurrence.

The next important statistic is that of Chevassu.

Of 100 cases collected by Chevassu, 19 were living four years after castration. As to the histological type of tumor, in these cured cases, 16 were "epithelioma seminal," a tumor characterized by Chevassu as seminoma. Only three were of the mixed type, ordinarily known as embryonal sarcoma.

A recent and important statistic is that found in a brief report of Codman, who collected 80 cases treated at the Massachusetts General Hospital within the last forty years, 63 having reports of pathological examinations of the specimens removed. Sixteen cases could not be traced. Of the 64 cases traced, 13 were living, 12 died of other causes, of these 10 had been operated upon. Thirty-nine died of the disease, 33 with, 6 without operation, giving a mortality of the disease of 61.9 per cent. Of the 56 cases operated upon, 13 were living—average time after operation 8 years, extremes 2 and 28 years. Ten died of some other trouble—average time after operation, 10 years, extremes 7 months and 26 years. Twenty-three, or 41.07 per cent of those operated upon, survived the disease. If 8 unoperated and 12 cases operated upon when metastases were evident are excluded, we find that 52.27 per cent were cured. From this study, Codman concludes that, "the prognosis of sarcoma of the testicle, while bad, is not,

<sup>1</sup> Am Jour of Med Sciences, 1899, vol 117, p 35

<sup>2</sup> Thesis of Paris, 1906, Rev de Chir, 1910

<sup>3</sup> Boston Med and Surg Jour, February 19, 1914, p 267

when operated, so universally bad as text-books would lead us to infer " These statistics going back over a long period include a number of cases in which the diagnosis was not confirmed by microscopical examination and cannot fairly be compared with Chevassu's series or the later statistics of Hinman

My own series of cases furnishes few data as regards the prognosis of sarcoma of the testis after operation, inasmuch as the great majority of cases were referred to me after a recurrence had taken place and many in a very far advanced and hopeless stage of the disease, only 9 cases were operable when referred to me. On the other hand, the very nature of this series of cases throws further light upon two very important questions

1 Can anything be done after primary operation to improve the prognosis?

2 Can anything be done with even a remote chance of cure after recurrence has taken place?

The most recent statistical study giving the result of operative treatment of the testicle, is the admirable paper of Hinman, assistant resident surgeon, Johns Hopkins Hospital, read before the meeting of the American Medical Association, June, 1914 (*Jour A M A*, December 5, 1914)

An analysis of the 32 cases reported is of great interest, 25 were admitted to the Johns Hopkins Hospital, 2 were not treated, and in 7 the operation was performed outside and the specimens sent to the laboratory of Dr Jos C Bloodgood for diagnosis. Seven of the tumors occurred in the undescended testis, which, Hinman states, supports the accepted view that malignancy is relatively more common in men with undescended, than normally descended testes

The age limits were twenty-four and sixty-seven years, 8 were under thirty

As regards trauma, it is stated that in 11 cases or 33 per cent there was a history of some antecedent injury

The duration of the disease from the time it was first noticed until operation, varied from one month to 20 years. Hinman states that 4 cases of the series in which the patients are still alive, had a pre-operative duration of four months, two years, six years and twenty years. He concludes that the duration gives no clinical indication of the character or degree of malignancy

He states that the pathologic material was personally examined in 22 of the cases. Parts of all of these showed a picture typical of these testicular tumors and not duplicated by any other tumor, in the presence of characteristic large round cells in a lymphoid or fibrous stroma. In 10 of the cases in addition to these typical areas of carcinoma cells there were found, either alone or in association, areas of cartilage or of cystic, glandular, myxomatous

fibromuscular or embryonic connective tissues, which he states place them in the group of teratomas. The round cells of the simple-cell tumors were in all cases larger than lymphoid cells, and the round-cell picture in the two types of tumors was absolutely identical. In the majority of the tumors in which cartilage was found it was present in small areas and might easily be overgrown by the more active carcinoma cells, and this may have occurred in these pure-cell tumors. In 6 of the 10 cases in which no material was available for study, a previous microscopic diagnosis of alveolar or round-cell sarcoma has been made. Hinman states that in view of the fact that the previous diagnosis of the 12 pure round-cell tumors and of 3 of the mixed tumors had been some form of sarcoma, it is to be supposed that these 6 cases were either teratomas or a one-sided development of a teratoma. "These findings," he states, "only confirm those of Ewing, namely, that, clinically, all malignant tumors of the testicle are of teratomatous origin."

Hinman states that there were a number of cases with the clinical diagnosis of malignancy in which the removed testicle, on subsequent microscopic examination, proved to be the seat of syphilitic orchitis.

Metastases were clinically present at the time of the operation in four of the patients, all of whom died of carcinomatosis. Seventeen patients had retroperitoneal glandular metastases at death. In 8, death is said to have been due to general carcinomatosis and presumably lumbar metastases were present.

The ultimate result is known in 24 cases, of which 20 are dead and 4 living. Of the 18 cases in which the result is known and the specimens have been examined, 9 are pure round-cell carcinomas and 9 are teratomas. Of the former group two patients are alive, one 12, the other 13 years. None of the seven patients that are dead lived over 2 years. Of the latter group (teratomas) all are dead except one, who is now alive for only 16 months. Hinman believes that this shows the higher malignancy of the mixed type, which is in accord with Chevassu's opinion.

In the 4 cases in which the material was not available for study, one is alive 12 years, the other three died one, two and eight years, respectively, after operation.

In view of the very bad prognosis of the ordinary surgical treatment of cancer of the testicle by removal of the testis and cord, Hinman strongly advocates the radical operation proposed by Chevassu, in most cases, and gives the first complete resume and analysis of the cases thus far operated upon by the radical method. He has collected 44 attempts at radical removal of the primary pre-aortic lymph area in treating testicular tumors. The fact that over 7 per cent of the few cases so far reported that have been subjected to the radical method were found on subsequent examination of the specimens to have had syphilitic orchitis, has induced him to advocate doing the operation in two stages: (1) simple castration and thorough histological examination of the tumor, (2) the operation for removing the lumbar glands. The latter is a very extensive operation and is carefully described by Chevassu and Hinman. It is, however, the results of the cases thus far operated upon that chiefly concern us here. Five of the patients died of post-operative complications, three of pneumonia, two of peritonitis, giving an operative mortality of 11 per cent.

With the exception of two cases there was no clinical evidence of lumbar metastases before operation. Of the remaining 42, 20 were living, 9 over 2 years,

## CANCER OF THE TESTIS

the longest 4 years and 10 months, the shortest one month. The average time since operation of the 20 reported alive is one year and 8 months. Sixteen or 41 per cent have died of cancer, all within one year, except 2.

While the lumbar glands were palpable in only two cases before operation, 22 or over 50 per cent of the cases showed cancer invasion of the lumbar nodes removed at operation, and in 11 of these the involvement was so extensive as to be inoperable. In 8 of the cases in which the lumbar glands were removed, subsequent microscopic examination showed no cancer invasion. In 3 no lumbar glands were found at operation. All of the 11 patients in whom the glandular involvement was so extensive as to render its complete removal impossible, are dead, except 2 who had been observed for only one month. Of the 14 patients with glandular involvement in which the glandular area was supposed to have been completely removed at operation, 7 are living, one died of pneumonia 7 days after operation and 6 died of a recurrence of the cancer. Of the 8 patients with clean glandular removal, but in which no involvement could be found, 5 are living and 3 died of cancer. Two of the 3 in whom no glands at all were found, are dead. Of the 6 in which no mention is made of glands, 2 are dead, one and twelve months after operation, 3 are living, 1, 12 and 48 months.

Of the 6 patients referred to, who had glandular metastases removed, one, in whom 2 of the glands removed at operation showed marked invasion, is now alive and well almost five years after removal, 3 other patients are alive with no evidence of recurrence for almost 3 years from the time the glands were removed, and 2 other patients were alive after operation, 8 and 1 months, respectively, at the time of the last report.

Among the conclusions reached by Hinman are

Orchidectomy will cure from 15 to 20 per cent of teratoma testis. Obviously a cure is possible only when the testicle is removed before the onset of glandular or other metastases.

"The experience of various surgeons in a total of 46 cases has demonstrated in suitable cases the feasibility and technical ease of the radical operation with a combined mortality in all cases of only 11 per cent."

At first sight, the argument in favor of the radical operation so strongly urged by Chevassu and Hinman seems cogent and sound, but after a more careful analysis, several weak points appear. Taking Hinman's own figures, we find that about 50 per cent of the cases subjected to the radical operation showed no involvement of the glands at all, and hence, 22 patients had to undergo a very grave operation only to find that there was no occasion for it. The next and very important point is, that in 11 cases, or about 25 per cent of the total number, the glands were found to be so extensively involved that the condition was inoperable. In other words, in 50 per cent of the cases operated upon, no glands were present, and in 25 per cent, the condition was so far advanced as to make surgical removal impossible, thus, in 75 per cent of the cases no benefit was offered from the operation.

We find then this very formidable operation with a mortality of 11



per cent advised as a routine measure in all cases of cancer of the testicle, when it offers no hope of benefit in 75 per cent of the cases. Therefore, it is clear that the only ground for justifying the operation must be the benefit that it offers in the small group of 25 per cent of the cases, in which the glands were found at the time of the operation, and it was possible to remove them surgically. In this group we find, out of 14 cases operated upon, 6 died of recurrence, and one died from the operation, leaving seven cases still living at the time of the report.

The duration of life after operation in a few of these cases is insufficient to justify classing them as cures, only 1 was well over 3 years. Therefore, at present we can safely state that we have no data for estimating the number of actual cures. I do not believe the number of lives saved by the radical operation, sufficient to offset the mortality of the operation itself.

Another serious objection to the operation, in my mind, is, that even though no glands are found after a most careful dissection, this does not mean that they are not present, since of eight cases, of Hinman's collection, in which no involvement could be detected after a clean removal of all the glands, three died of cancer. Another most striking fact is, that of the three cases in which no glands could be found, two are now dead from a recurrence.

#### OPERATION REMOVAL OF TESTIS AND CORD, FOLLOWED BY PROLONGED TOXIN TREATMENT

I believe that my own series of cases show that cancer of the testis treated by simple orchidectomy, without any appreciable risk, and followed by a thorough course of treatment with the mixed toxins of erysipelas and bacillus prodigiosus (also without risk), have a far better prognosis than those subjected to the very extensive laparotomy with removal of the lumbar glands, as advocated by Chevassu and Hinman.

In comparing my own results with other series of cases of cancer of the testicle, it is important to note that my series represents an entirely different type of cases from the others, inasmuch as in the majority of cases the disease was far advanced at the time when the patients came under my observation. In only 9 the toxins were given immediately after primary operation before recurrence had taken place, and yet in spite of this, 13 patients were well beyond a period of 3 years, and only 2 of these recovered without the use of the toxins, furthermore, both were of the teratoma type, one almost a pure tera-

toma and probably not malignant, the other a teratoma with carcinomatous degeneration

It is further worthy of note that 2 of the cases of this series were cancer of the undescended testis. In one case the toxins were used after operation and the patient remained well over three years, when he died either of metastases or tuberculosis, probably metastases. In the other, the toxins were used as a prophylactic after operation, the patient is now well, 8 years.

Very few recoveries from sarcoma of the undescended testicle are to be found in the literature.

Dr Robbins has sent me a more detailed report of his case mentioned in the discussion of Hinman's paper (*Jour A M A*, December 5, 1914). It is as follows:

Male, age fifty-five years, carpenter. Family history negative, no history of trauma. Patient had some enlargement of the right side of scrotum—whether due to hydrocele, or enlargement of the testis itself, it was impossible to determine for a period of twenty years. He was tapped several times during the year prior to the operation. The last time, bloody fluid was obtained, and a rapid increase in the size of the testis was noticed.

*Operation* (January 7, 1909)—A large tumor of the testis was removed, the lower part of which was elastic in consistence, and the upper, comparatively hard. The tumor was partly broken down at the time of the operation. Some portion of the healthy testis remained. A rapid, local recurrence followed, and on June 22, fifteen days after the primary operation, a second operation was performed, which consisted in the removal of a large portion of the scrotum on the same side, and the cord as high up as the internal ring, leaving apparently clean normal tissue. One week later (January 28) a well-marked local recurrence appeared, and grew very rapidly. Believing that there was no hope in further operative interference, the patient was put upon the mixed toxins of erysipelas and bacillus prodigiosus, the dose being carried up to the point of producing severe reactions—temperature of 102°–103°. No further growth was noticed, and the recurrent tumor slowly disappeared. The patient was discharged from the hospital on February 15, 1909, and the injections were continued for some weeks longer, twice a week. He remained in good health for four years, when he developed nephritis, which proved fatal. There was at this time no evidence of any return of his old trouble.

Hertel of Copenhagen, Denmark (*Hospitalstidende*, April 7, 1909), in a paper upon "The Treatment of Sarcomata with Coley's Fluid" reports 2 cases of inoperable recurrent sarcoma of the testis treated with the mixed toxins of erysipelas and bacillus prodigiosus. He states that the outcome is highly encouraging for the utilization of these injections in suitable cases. He will feel obliged in the future to employ Coley's fluid in all sarcoma cases which may come under his treatment, even when he feels certain of having removed all sarcomatous tissue in a radical operation.

The first case, male, twenty-nine years of age, upon whom castration had

been done at the hospital in 1904, for sarcoma of testicle. A recurrence was observed a year later in the inguinal glands, which were then extirpated. Two years later there again was an extensive recurrence in the same region and a third operation was advised, although the danger and possible uselessness of such procedure were fully appreciated. Lennander's operation was performed and, in the course of the same, infiltrated glands were seen to extend upwards along the iliac vessels, and some of these had to be left behind as they could not be reached. The expected femoral thrombosis did not occur and the wound healed within a month after operation.

In the hope of perhaps influencing the sarcomatous tissue that had been left behind, Hertel, in January, 1908, began the use of the mixed toxins in doses of from three to twenty cgr. On March 20, the patient was discharged well and at the time of the report, November, 1908, was presented before the Koege Medical Society in good condition, without a trace of recurrence. A recent letter from Dr. Hertel tells me that the patient has remained well now 10 years.

Hertel's second case was that of a man, thirty-nine years of age, in whom, likewise, the testicle had been removed for sarcoma. A few months later there was a large recurrence in the abdomen, which seemed inoperable. The toxins were begun at once with the result that the nodules became softer and more fluctuating, although the size of the abdomen did not diminish. He grew constantly weaker, developed ileus and died. Autopsy showed a single large retroperitoneal cyst. Hertel states, if this diagnosis could have been rendered during life, the cyst might have been emptied through a lumbar puncture and the remaining cyst wall could have perhaps been made to disappear through continued treatment with the toxins. There was no trace of recurrence elsewhere.

These two cases of Hertel's offer very strong evidence of the value of the toxins in recurrent sarcoma of the testis even in the presence of extensive involvement of the retroperitoneal glands.

If results like these found not only in my own series of cases, but confirmed by other observers, can be obtained by the use of the toxins it would seem to be much more rational and logical to advise a thorough course of the toxin treatment as a prophylactic immediately after operation, rather than subject all cases to the very grave operation of extensive dissection of the abdominal glands, especially if such an operation is associated with a mortality of 11 per cent.

*Trauma*.—My series show a definite history of antecedent trauma in 33 per cent of the cases. This history was so clear and definite in most instances that it is quite impossible to brush it lightly aside as a mere coincidence, as most writers have done. That antecedent, local trauma is a very definite causative factor in the etiology of malignant tumors of all types and in all localities, must be regarded as a well established fact, and particularly is this true in tumors of the testicle, breast and long bones. For further proof of this theory I would refer

to my paper upon "Injury a Causative Factor in Cancer," ANNALS OF SURGERY, 1912

*Site of Recurrence*—My series of cases show that recurrence took place in the inguinal region in 6 cases, in the other testicle in 2, in the supraclavicular glands in 2, in the tongue in 1, axillary glands 1, lungs 2, retroperitoneal glands in 42

These cases show that the statement made by some writers that recurrence is practically always found in the abdominal glands, is not strictly true

As regards the type of cell, my cases show sarcoma in 47, teratoma in 2, carcinoma in 2, melanotic sarcoma in 1, fibrosarcoma in 1, mixed-celled sarcoma in 1, small round-celled sarcoma in 7

The following is a brief report of patients who have remained well upwards of three years

CASE I—Male, forty-four years of age In 1899, testis was removed at the New York Polyclinic Hospital by Dr John A Wyeth The diagnosis of round-celled sarcoma was confirmed by microscopical examination One year later the disease recurred in the other testis, and castration was strongly urged by the attending surgeon, but refused by the patient He was put upon the mixed toxins of erysipelas and bacillus prodigiosus, the treatment being carried out by Dr W J Robinson of Danville, Va The tumor very quickly disappeared Eight years later, I personally examined the patient, and found him in good health, with no trace whatever of a recurrence He was still well, when last traced, thirteen years later

CASE II—E O T, forty-six years, operated upon February 23, 1906, for a rapidly growing tumor of three months' duration No history of tuberculosis or specific disease Pathological report round-celled sarcoma of extreme malignancy A personal examination, March 22, 1906, showed a small lump, the size of a hazel-nut, in the groin, with enlargement of the deep iliac glands The patient was immediately put upon the mixed toxins which were continued, three times a week, for seven months, fairly good reactions being obtained He is still in good health, at the present time, eight years later

CASE III—J P N L, adult, operated upon at the Mayo Clinic in November, 1910, for a sarcoma of the left testicle Diagnosis confirmed by microscopical examination The mixed toxins were started shortly after the operation, and continued by the family physician, Dr Embree of Gayville, S D, under my direction, for nearly three months The patient is in good health at present, with no sign of a recurrence, nearly four years later

CASE IV—W M H, twenty-six years, operated upon February 1, 1906, by Dr J E Simmons of Omaha, Nebraska, for a rapidly growing tumor of three months' duration Microscopical examination proved the disease to be round-celled sarcoma The toxins were started by me, and later continued by the family physician for about six months The patient is at present well, with no sign of a recurrence, eight years later

CASE V—S, age forty-three years, operated upon in the summer of 1910

## WILLIAM B COLEY

for a rapidly growing tumor of the left testicle, the clinical history and physical signs of which pointed to sarcoma. This diagnosis was confirmed by a number of prominent surgeons. No evidence of tuberculosis, Wassermann negative. About two months later a recurrence took place in the groin, and a second, apparently incomplete operation was performed in the latter part of August, 1910. One month later, after recovering from the operation, the toxin treatment was started by Dr Percy Shields of Cincinnati, Ohio, and continued until July, 1911. The largest dose given was ten minims. The patient is in good health at present, four years later.

CASE VI—The following history was given to me by Dr Wm Mabon, superintendent of the Manhattan State Hospital. In 1890, patient was operated upon for a tumor of the testicle, which, on microscopical examination, was pronounced sarcoma. Five years later a growth appeared upon the tongue, and increased in size. Extirpation of the tongue was advised by Dr Mabon, but the patient's family objected so strongly to such a radical operation, that Dr Mabon decided to try the mixed toxins before excision. Previous to this a section of the tumor was removed by exploratory operation, and submitted to Dr Wm H Welch of Johns Hopkins, who pronounced the trouble round-celled sarcoma. The patient proved very susceptible to the toxins, severe reactions following relatively small doses. The tumor entirely disappeared under the treatment and, in a letter received from Dr Mabon, under date of March 5, 1910, he states that he has just heard from the patient's wife, who reports him to be in good health, fifteen years after the treatment was started.

CASE VII—J D, aged thirty-two years. Referred to the General Memorial Hospital in December, 1908, for an irreducible scrotal hernia. In addition to a large hernia, we found a large, solid tumor the size of a fist, extending up to, but entirely outside of, the hernial sac. Operation testis removed, which on microscopical examination by Dr Ewing, was pronounced carcinoma. The patient returned home three weeks later. I examined him personally, on January 31, 1912, at which time he was in good health with no evidence of a return.

CASE VIII—S C, forty-nine years, operated upon, July, 1906, by Dr Schoonover, of Yonkers, N Y, who pronounced the disease round-celled sarcoma. Two months later a recurrence took place in the abdomen, followed by enormous swelling of the leg and thigh. The toxins were then begun under my direction, and, almost immediately after, the swelling began to decrease in size. The treatment was continued from December, 1906, to February, 1908, at which time the swelling had almost entirely disappeared. The patient received nearly 200 injections of the toxins. The disease finally recurred, causing death in July, 1909.

CASE IX—P G, aged fifty-one years, was first seen in consultation by Dr Howard Lilienthal, in December, 1908. Operation December, 1908, by Dr Lilienthal, who found the testicle, about the size of a closed fist occupying a position in the left groin, directly over the aponeurosis of the external oblique, in other words, an inguino-superficial type of undescended testis. Microscopical examination made by Drs Mandelbaum, Welch, and Ewing, who pronounced the disease round-celled sarcoma. The tumor was removed to a level with the external ring. Two days later the toxins were begun and carried out by

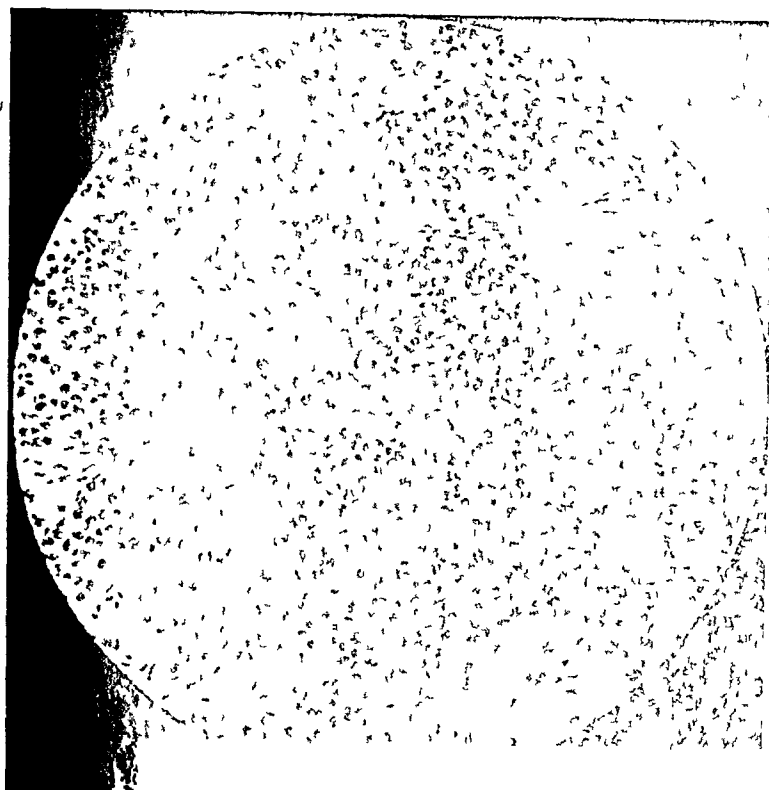


FIG 1 —Case I Embryonal carcinoma of testis

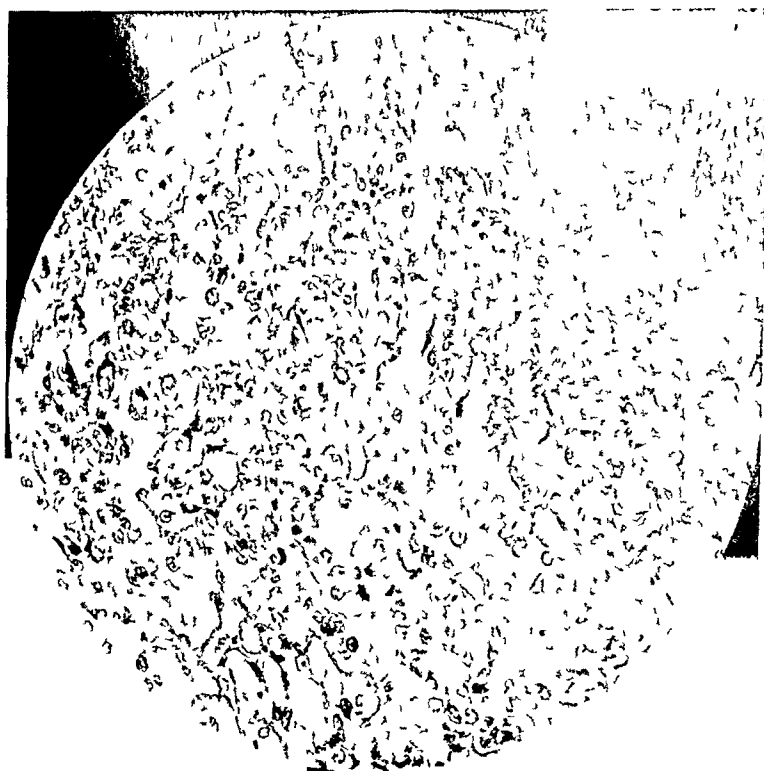


FIG 2 —Recurrent sarcoma of testis This section from supraclavicular recurrence



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Dr Lilienthal under my direction The patient is now in good health, December, 1914, or six years thereafter

CASE X—Dr D E B, aged thirty-seven years Family history no syphilis, tuberculosis of lung for past ten years Two weeks before the first operation, noticed pain in the left hip, together with slight enlargement, and tenderness in the right iliac region, and over the bladder He consulted Dr John B Murphy of Chicago, ten days later, who immediately operated and found a tumor the size of a closed fist As soon as he recovered, he was sent to me for the toxin treatment (a full history of this case is given below in the list of Undescended Testis cases)

CASE XI—G J, aged twenty-seven years, no history of trauma In April, 1900, first noticed enlargement of the testicle Operation December 10, 1900, at which time I removed a tumor the size of an orange, which proved to be a typical teratoma of the testicle A microscopical section had already been reported upon Patient received the toxin treatment, and when last heard from, three years later, was in good health

The following is a brief record of my personal cases of cancer of the undescended testicle

CASE I—Dr D E B, thirty-seven years, referred to me by Dr J B Murphy of Chicago, on July 8, 1908 The left testis had never been in evidence No specific history The patient has suffered from tuberculosis of the lung for ten years The first symptom was dull pain in the region of the left hip, very severe the second night, it then grew less and disappeared Shortly afterward he noticed a slight enlargement of the left inguinal and iliac region, extending toward the bladder, slight tenderness on pressure Ten days after the first symptom, he consulted Dr John B Murphy, who operated immediately, and found a tumor the size of a closed fist, completely involving an undescended testis Microscopical examination proved the tumor to be round-celled sarcoma As soon as the wound had healed, Dr Murphy referred the patient to me for the toxin treatment as a prophylactic against recurrence The entire tumor was sent on and examined by Dr Jas Ewing, who confirmed the diagnosis made The patient was put upon the mixed toxins and proved to be very susceptible, a reaction temperature of  $106^{\circ}$  following a dose of 3 minims In December, 1908, the old tubercular trouble became active again and the patient went to Wyoming The toxins were still continued and gradually his general health became greatly improved, his weight was 170 pounds He remained in good health without sign of recurrence until the latter part of 1911, when symptoms of abdominal recurrence appeared He died early in March, 1912

I think it is fair to assume that the toxins used after operation



played some part in preventing a return of the disease until three years later

CASE II—S B, forty-two years of age, referred to me November 20, 1906, had always had a right undescended testis, no history of trauma In the spring of 1906 he noticed enlargement of the undescended testis region Operation was done at the Presbyterian Hospital in June, and the tumor proved to be a sarcoma A few weeks later numerous tumors appeared in the abdomen, and a second operation was performed in October, by Dr Wilken of the City Hospital A vertical incision was made just outside the right rectus, and a tumor, the size of a cocoanut removed Temporary improvement followed, but a recurrence took place shortly in the shape of a large number of tumors involving the retroperitoneal and mesenteric glands Physical examination by myself on November 20, showed the patient markedly emaciated and anæmic, and in a desperate condition The toxins were given for a short time, without apparent effect Death occurred a few months later

CASE III—*Spindle-celled sarcoma primary in the undescended testis, involving mesentery, omentum and lower half of kidney* S C, forty-four years, farmer, case of Dr Maskel Lee, of Wapella, Ill, no history of trauma This is another example of abdominal ectopia The first symptom in this case was pain in the left chest, passing down the left side to the groin There was slight loss of weight The first examination by Dr Lee showed a large tumor,  $\frac{1}{2} \times 7$  inches, extending from the left iliac crest to  $1\frac{1}{2}$  inches to the right of the umbilicus, firmly fixed, skin not adherent Temperature  $96^{\circ}$ , pulse 80, urine highly albuminous, no blood count taken The patient was sent to a hospital and kept under observation for ten days The diagnosis of inoperable tumor, probably sarcoma, was made The patient was then taken to the Rochester Clinic and an exploratory operation was done by Dr Wm J Mayo on March 11, 1913 The abdomen was opened 2 inches to the left of the umbilicus and an immovable tumor was found, starting from an undescended testicle, involving the mesentery, omentum and lower half of left kidney Microscopical examination proved the tumor a spindle-celled sarcoma The disease was entirely inoperable and Dr Mayo advised the mixed toxins The treatment was begun by Dr Lee on April 9, under my direction, the doses ranging from  $\frac{1}{2}$  to 6 minims, followed by well-marked reactions After the fifteenth dose, Dr Lee states

"There is evidently marked softening with decrease in size and the pain ceased after the sixth injection" After the thirty-

second injection, Dr Lee writes "The patient's condition is improved in every way, the tumor has diminished in size, softened and loosened, he sleeps and eats well and has gained some weight"

After the sixtieth injection, Dr Lee writes

"It is now a little over six months since the treatment was begun The tumor is slowly but surely disappearing It has decreased in size fully one-third No pain, gain in weight"

The improvement continued until the early part of November, when he began to have obscure pains in various parts of the body and rapidly declined until he died on December 4, evidently of general metastases

CASE IV—I N R, thirty-five years This is a further example of abdominal ectopia No testicle ever noticed on right side Two years ago, in 1903, he began to have pain in the right inguinal region, he consulted Dr J B Waterman of New York, who thought it might be due to a hernia and ordered a truss The truss only aggravated the pain and the patient consulted a Chicago surgeon, who made the diagnosis of appendicitis, for which operation was performed on July 24, 1904 An incision was made in the right iliac region and an enlarged testis was found which extended so far toward the median line, that a second incision through the right rectus was made On microscopical examination the tumor proved to be a teratoma with sarcomatous degeneration There were no adhesions and the sarcoma part was all within the capsule of the tumor The patient was referred to me for the toxin treatment, which was begun in September and continued in small doses up to February, 1905, never sufficient to cause any severe reactions Physical examination January 28, 1905, showed a well-marked induration in the right iliac fossa and a thickening of the scar in the right rectus muscle, the abdomen itself was also somewhat enlarged, his general health was apparently not yet affected Death occurred within a year

CASE V—*Sarcoma of the undescended testis, inguinal ectopia, trauma in early childhood* P G, fifty-one years While playing ball during boyhood, he was struck in the left testicle, which was followed by considerable swelling and inflammation At this time the testicle retracted into the inguinal region, where it has remained ever since In 1905 or 1906 he began to have periods of discomfort and pain in the left groin, in the summer of 1907 he noticed enlargement of the testicle which then rapidly increased in size Operation December 3, 1908, by Dr Lilienthal, who found the testicle about the size of a closed fist, occupy-

ing a position in the left groin, resting upon the aponeurosis of the external oblique, instead of underneath it, pointing to an inguino-superficial type of maldevelopment. No communication was found with the abdominal cavity at the operation. The testicle was removed and found to be markedly broken down, resembling very much the caseation of tuberculosis. Microscopical examination made by Drs. Mandlebaum, Welch and Ewing proved it to be *round-celled sarcoma*. After recovery from the operation, I saw the case in consultation with Dr. Lilienthal and advised the toxins as a prophylactic measure. The treatment was given for several months by Dr. Lilienthal and the patient is in good health at present, nearly six years later.

This, I believe, is the only case of sarcoma of the undescended testis on record, well over three years.

CASE VI—S. W., twenty-nine years. Patient had worn a truss for a year, five years ago, this caused so much pain, that it was left off. He consulted me in August, 1908, and stated that three years ago he suffered from gonorrhœa and prostatitis, the left testicle became swollen shortly after this. Eight months ago he had a second attack of gonorrhœa with inflammation of right and left testicle. He complained of a vague feeling of discomfort and pain six months ago, the pain being localized chiefly in the left loin. One month ago a tumor was first noticed in the pelvic region. Operation by Dr. Charles L. Gibson of St. Luke's Hospital in July, 1913, who found a tumor apparently involving an undescended testis, superficially on the right side, deeply on the left, extending across the whole abdomen and bladder, involving the bladder wall. Microscopical examination showed the tumor to be *carcinoma*. It was the size of two fists and pronounced inoperable.

CASE VII—A. H., fifty-five years (abdominal ectopia). Referred to me by Dr. Thos. J. Harris, of New York City, on July 9, 1913. Operation had been performed in the early part of 1911, by a New York surgeon, for what was believed to be a hernia. At the operation, however, a large tumor was discovered, evidently malignant, occupying the iliac fossa and lower abdominal cavity. It was regarded as too extensive for complete removal. A portion was excised for microscopical examination, and proved to be sarcoma. An attempt later was made by another surgeon to extirpate the growth, but it was found impossible to remove it entirely. The patient showed temporary improvement for three months, and then began to get worse, pain and hæmaturia recurred. In July, 1913, he was seen in consultation by myself, and the toxins were advised in the hope of bringing temporary

relief They were given for six weeks in small doses, with little apparent effect The patient grew rapidly worse, and died a few weeks later

CASE VIII—D T, thirty-one years Family history negative Left testis undescended at birth The patient had noticed enlargement of the left testicle during the year preceding operation, which latter was performed by a prominent surgeon of New York in June, 1909, for a left inguinal hernia and left undescended testis An attempt was made to bring the latter into the scrotum, but it subsequently retracted into the inguinal region No other history of injury In 1910 enlargement of the testicle became apparent and he consulted a surgeon, but was told it was of no significance There was no pain at any time, although the swelling increased rapidly in size, and the patient lost considerable weight An operation was performed by Dr Friend of the Michael Reese Hospital of Chicago in June, 1911 The microscopical examination was made by Dr W J Jobline, from whose report I quote

From the presence of cartilage cells and two different definite types of tumor, it is very probable that the original growth was a teratoma undergoing malignant change It may be called a malignant embryoma

The patient consulted me in July, 1911, but there was already marked evidence of recurrence with extreme emaciation and general metastases, so that I believed the case too far advanced for the use of the toxins Death occurred shortly afterward

CASE IX—J R S, thirty-three years Family history good Double undescended testis since childhood First operation in June, 1905, by Dr Wyeth, at the New York Polyclinic, both testes were removed for sarcoma The right was the size of a goose egg, the left  $2 \times 3\frac{1}{2}$  inches in diameter Microscopical examination was made by Dr Jeffries of the Polyclinic Laboratory The patient remained well until 1907 when he had an attack of abdominal colic Similar attacks occurred in 1908-1909, pain and indigestion followed and a general falling off in health In 1911, he had three severe attacks of colic, in 1912, four He had very severe pain in the abdomen, which was followed by moderate temperature,  $99^{\circ}$  to  $100^{\circ}$ , and great prostration A mass, the size of a fist, appeared in the retroperitoneal region, this increased in size, and the patient was brought to me by his brother, a surgeon of the South, in May, 1912 Physical examination at this time showed the patient considerably emaciated, a large, apparently inoperable tumor could be palpated in the retroperitoneal region I started the toxins, but gave a hopeless

prognosis, believing that nothing more than slight temporary retardation could be expected from the treatment. The latter was carried out by his brother who, under date of June 4, 1912, stated that the patient had gained 8 pounds in weight since the treatment was begun, that his color had improved and appetite was splendid and his strength sufficient to enable him to resume his business, there was no perceptible change in the size of the tumor. September 21, 1912, Dr S writes "the patient has gained 19 pounds in weight and his general health is splendid. There is a decided decrease in the size of the inguinal glands, the tumor has diminished in size to some extent and feels softer."

The improvement, as I had predicted, proved temporary only. In the early part of 1913, the patient began to get worse and death occurred on January 27, 1913.

CASE X—B H, twenty-two years. Possible trauma from previous operation in 1907, done for right undescended testicle and hernia, at another hospital. Testis brought into scrotum, not enlarged at that time. The patient first noticed enlargement in August, 1908. Operation was immediately performed and the testis found to be sarcomatous. The disease quickly recurred and a third operation was performed in October, 1909. The large mass of glands removed from the groin and iliac region also proved to be sarcoma.

CASE XI—H W B, thirty years, was referred to me in December, 1906, the left testicle had never descended, patient never wore a truss. In October, 1903, he began to have pain and swelling in the undescended testis. In March, 1904, the tumor, which had then reached the size of a goose egg, was removed by Dr J K Warren of Worcester, the patient at the time had already lost 20 pounds in weight. About 1½ years later a recurrent tumor, the size of a hen's egg, was noticed in the left groin. The inguinal and iliac glands were also involved. The patient was then referred to me for the toxin treatments, which were used for six weeks in conjunction with the X-ray, without improvement. The patient died a few months later.

CASE XII—Case of Dr Geo H Walter, Orangeburg, S C (abdominal ectopia). Although this case did not come under my personal observation, I was consulted by Dr Walter in regard to carrying out the treatment. The patient, an adult, had never noticed or felt the left testicle. He had observed a tumor in the left iliac fossa for a number of weeks, causing him continuous pain in the legs and back. The first operation was performed by Dr A E Baker, of Charleston, S C. A tumor, the size of a coconut, partially broken down, was removed. Three weeks

later, a second operation was performed by Dr Walter, who found a large mass in the left side, just below the umbilicus, with cancerous involvement of the glands of the intestine. I advised the use of the toxins in this case, but in a letter dated August 19, 1913, Dr Walter stated "The case had too far advanced when the toxins arrived, the patient died three days later."

This case, I believe, is perhaps the most malignant on record. Dr Walter stated "The growth developed with extreme rapidity, in five weeks after the removal of the testicle, the mass which appeared in the left side of the abdomen, opposite the umbilicus, had spread until it involved stomach and pancreas, down to within an inch of the left hip."

CASE XIII—Since this paper was written, Dr W W Grant of Denver, Colorado, has sent me the history of a very remarkable case of abdominal ectopic testicle. The case had been treated with the toxins for nearly a year, under my direction. The chief point of interest is the fact that when the toxins were begun there was swelling of the legs, and a large inoperable tumor in the abdominal cavity, which became very much smaller under continued treatment. It again increased rapidly in size during a short period of rest from treatment, but as soon as the toxins were renewed it again showed diminution in size, with disappearance of the swelling in the legs.

January 30, 1915, an abdominal incision was made, and the entire tumor was removed without great difficulty. The testicle was plainly observed in the centre of the tumor. Pathological report made by Dr R C Whitman of Denver (a very competent pathologist) stated that it was a typical large, round-celled sarcoma, that is, certain portions showed a typical sarcomatous structure, while others had some appearance of the usual carcinoma,—again emphasizing the difficulty of classifying these tumors. He was again put upon the toxin treatment after operation. (This case will be reported in full by Dr Grant.)

Note—A full report of my results in the treatment of inoperable sarcoma in general by the mixed toxins of erysipelas and bacillus prodigiosus, including 124 cases successfully treated by other surgeons, may be found in the Transactions of the Third International Cancer Research Conference, Brussels, 1913.

## SARCOMA OF TESTIS

No	Age	Date	Side	Antecedent trauma	Duration	Testes normal or ectopic	Type of tumor	Treatment	Result	Final Remarks
1	26	1906	R	Yes Bruise, swelling at once, subsided, returned 3-4 weeks	Noticed 3 months before operation	Scrotal	Sarcoma	Removal Jan, 1909, mixed toxins (Coley) after operation	Well 1914, 8 years later	
2	34	1909	L	No	3 months before operation	Scrotal	Sarcoma	Removal Jan, 1909	Recurred in retro-peritoneal region in 6 months	Death Nov 30, 1909, total duration of life, 1 year
3	21	1913	R	No	1 month before operation	Scrotal	Sarcoma	Removal Dec 12, 1913 by Dr Homer Gage	Jan, 1913 internal metastasis, rapid decline, toxins for 2 weeks small doses, but condition so bad, given up	Died July 1913, total duration of life, 8 months
4	25	1912	L	Yes Squeezing injury soon after	1 year	Scrotal	Fibrosarcoma	Removed in 1910 by Dr Geo Ben Johnston	Recurred in abdomen 2 years later large abdominal tumor cachexia, April 10, 1912	
5	32	1908	L	No	?	Scrotal, associated with large hernia not known until hernia operation	Carcinoma	Operation Dec, 1908, W B Coley	In good health Jan 3, 1912, personal examination	
6	42	1907	R	No	3 months	Scrotal	Sarcoma	Operation Nov 22, 1907, Dr Porter, of Boston	Toxins begun Dec 10, 1907	?
7	37	1909	R	No	5 weeks	Scrotal	Sarcoma	Operation Oct, 1909, by Dr H H Young	Recurrence in abdomen, 4 months	Toxins after, large recurrence, little effect, died
8	42	1901	R	Yes 8 months, strain	8 months	Scrotal	Sarcoma, clinical diagnosis			
9	42	1908	R	Yes Horseback at once	10 months	Scrotal	Clinical diagnosis with inoperable metastasis testes typically sarcomatous	Case hopelessly inoperable when seen	No treatment	Died few weeks later

# CANCER OF THE TESTIS

10	38	1907	L	No	13 months	Scrotal, size of fist	Sarcoma	Operation by Dr Syms, of Chicago	2 months later recurred in abdomen	Oct 5, 1907 mass size of 2 fists in hypochondriac region
11	Ad	1892	R	No	?	Scrotal	Sarcoma	Operation removal of testis	Recurred in tongue 5 years later, large tumor, excision of tongue advised by Dr Wm Mabon	Mixed toxins (Coley) given, severe reactions. Entire disappearance, well 15 yrs, microscopic examination by Dr Wm H Welch Died
12	47	1906	R	No	3 years	Scrotal	Sarcoma	Operation, 1906, removal of testis	July, 1906 recurrence, right groin and iliac fossa with infiltration of all neighboring tissues, mixed toxins, marked temporary improvement	
13	48	1910	L	No	Few months	Scrotal	Sarcoma	Operation Sept, 1909	Recurrence in abdomen few weeks, retroperitoneal glands in six months, treated with mixed toxins, tumor apparently disappeared	Lost sight of, probable recurrence
14	55	1902	R	No	2 years, painless swelling	Scrotal	Round-celled sarcoma	Operation July 24, 1902	Recurred in 2 months, local and in groin, second operation	Rapid recurrence, toxins, slight temporary improvement
15	46	1906	L	No	4 months	Scrotal	Round-celled sarcoma	Operation Feb 23, 1906	1 month later apparent recurrence in groin and iliac gland	Put on mixed toxins, swellings disappeared, patient well May, 1914, 8 years
16	?	1912	R	No	4 months	Scrotal	Sarcoma (microscopic examination) Mayo's	Removal, Feb 6, 1912	Toxins after operation under my direction	Well Dec, 1914, nearly 3 years
17	37	1908	R	No	4 months	Scrotal	Sarcoma (microscopic examination)	Operation April, 1907, by Dr E Elhot, recurred in 10 months, in abdomen, very extensive, with marked emaciation	Death shortly after	



## SARCOMA OF TESTIS

No	Age	Date	Side	Antecedent trauma	Duration	Testes normal or ectopic	Type of tumor	Treatment	Result	Final Remarks
18	46	1904	R	Yes Injury to right testis, fall on fence rail in childhood	Slow increase in size 7 years, 4 years tapped and bloody fluid drained off	Scrotal	Sarcoma	Operation, Nov. 1903, by Dr Lister of Chillicothe, Ohio	Recurrence in abdomen 2 months after	Death within a year
19	32	1900	R	No	5 months painless lump	Scrotal	Sarcoma	Operation Nov. 15, 1899 by Dr B L Bangs	Recurrence in abdomen in 6 weeks very great pain	Death in few months
20	29	1897	L	Yes Fall from bicycle Aug 1896 injured left testis, tumor 2 to 3 weeks after injury	3 months	Scrotal	Sarcoma, melanotic	First operation by Dr Milbrook of Albrook many 3 operations for recurrence in 9 months Fourth operation by Dr Coley September 1897	Rapid recurrence, toxins 3 to 4 weeks, no effect	Death in 3 months
21	32	1912	L	Yes Fell on fence 18 years ago, swelling, which disappeared	3 months, no pain or tenderness	Scrotal	Sarcoma small round-celled	Operation Oct 7 1912 by Dr Kimball	Toxins after operation	Well July 1914
22	26	1908	R	No	6 to 7 months, painless enlargement	Scrotal	Sarcoma.	D W Wood, Nov., 1907	Recurrence in abdomen 5 months	Death
23	42	1904	R	Yes Injury to left testis getting out of bathtub April 1903 Swelling noticed 3 months later	4 months	Scrotal	Teratoma	First operation by Dr Chetwood, Oct 8 1903 recurred Jan 1 1904 Second operation Jan 28, 1904 by Dr Coley	Toxins for 2 months, little effect	Died Oct., 1904
24	28	1899	R	Yes Fall from bicycle injured right testis	1 year	Scrotal	Sarcoma microscopic examination	Operation Dec 1898, by Sir Alfred Fripp	Recurrence in abdomen 3 months later	Mixed toxins 6 months, slight but temporary improvement, death in 1 year

# CANCER OF THE TESTIS

25	28	1911	L	Yes Struck with baseball, severe pain 4 days, tumor 8 weeks	5 months	Scrotal	Sarcoma Mayo's oratory	Operation, Dec 2, 1910, Mayo's clinic	Toxins after operation for 1 year	In good health 1 year later
26	32	1910	L	No	6 months	Scrotal	Sarcoma	Operation, July, 1910	Symptoms of abdominal recurrence 2 to 3 weeks after operation	Sept., 1910 very large abdominal tumor, size of child's head, toxins given, little effect, died Oct 10, 1910
27	49	1907	L	Yes Fell astride board 14 years before, injured left testicle	2 years	Scrotal	Sarcoma	Operation, July, 1906, by Dr Schoonover	Recurrence in abdomen and iliac fossa in 2 months, enormous swelling of leg and thigh, toxins given	Almost complete disappearance of tumor and swelling, toxins given from Dec., 1906 to March, 1908 when tumor had apparently disappeared, recurrence and death July 1909
28	33	1895	L	No	2 months	Scrotal	Sarcoma	Operation, Mar., 1893, by Dr A T Cabot	Recurred in abdomen 2 years later	Toxins 2 weeks, no effect death shortly after
29	28	1906	L	Yes Injured testis riding 6 years before	3 months	Scrotal	Sarcoma	Operation May, 1906, by Dr Torek	Recurrence local 2 months, second operation	Metastasis supra-clavicular and abdominal glands, 2 doses of toxins 1 1/2 no reaction, died 3 days later probably embolism
30	Ad	1906	R	?	?	Scrotal	Sarcoma	Operation, Oct., 1904 by Dr Chas Stewart	Recurrence in abdomen 1 year later	Jan., 1906, toxins 1 1/2 to 15 caused cessation of pain & growth checked, death
31	31	1901	R	Yes Kicked in right testis enlargement noticed 2 years later	5 1/2 years	Scrotal	Sarcoma	Operation, Nov., 1906, metastasis in abdomen before testis removed	Rapid loss in flesh and strength	Died shortly after
32	22	1911	L	No Gonorrhea 6 months before	2 months	Scrotal	Sarcoma, mixed-celled	Exploratory laparotomy, July 1911, removal of some retroperitoneal glands by Dr A A Berg	Aug 29, 1911, left testis size of 2 fists, large tumor in abdomen	Death

## SARCOMA OF TESTIS

No	Age	Date	Side	Antecedent trauma	Duration	Testes normal or ectopic	Type of tumor	Treatment	Result	Final Remarks
33	22	1897	L	Yes Fell from bicycle and injured left testicle, enlargement soon after	Few months	Scrotal	Sarcoma	Operation, Aug 1896, Lenhardt	Local recurrence 6 months Second operation, June, 1897	Abdominal recurrence soon, death Oct. 1897
34	28	1901	?	No	2 years painless enlargement	Scrotal	Sarcoma	First operation Dec, 1899 by Dr DeGomo, recurrence 9 months in glands, in groin, and in abdomen	Rapid decline	Death
35	38	1900	L	No	4 years	Scrotal	Sarcoma	Operation, July, 1899, recurrence in abdomen	1 year later severe lumbar pain	Swelling in left leg, toxins marked improvement temporary
36	32	1902	L	No	22 years, increase in size only 8 months	Scrotal	Sarcoma	Operation, April 2 1902, by Dr Coley	?	
37	27	1900	R	No	9 months	Scrotal	Teratoma	Operation, Dec 12 1900, by Dr Coley	Patient in good health 3 years later	
38	?	1898	R	Yes Kicked in right testis by horse 2 years ago, small tumor Second injury 4 mos ago	4 months	Scrotal	Sarcoma, round-celled	Operation, Aug 11, 1898	Recurred in abdomen	Death in 1 year
39	35	1910	R	No	1 year	Scrotal	Sarcoma, round-celled	Operation, May 3, 1910	Recurred in abdomen toxins for several months	Death in 1 year after operation
40	30	1906	R	Yes 15 years ago fell and injured right testis, 10 yrs ago second injury	1 year	Scrotal	Sarcoma	Operation, Aug, 1906, by Dr Deaver	Recurred in abdomen in 6 months	Death
41	22	1909	R	Yes	6 months	Scrotal	Sarcoma	No operation, hopeless when first seen	Recurred in retroperitoneal glands	Died a few months later duration of life less than 1 year
42	24	1904	R	Yes Blow Dec, 1901, swelling at once	9 months	Scrotal	Sarcoma	Operation, Aug, 1902	Recurred 6 months axillary glands ribs and lung	Died July 25 1903

# CANCER OF THE TESTIS

43	35	1911	?	No	6 months	Scrotal	Sarcoma	Operation, 1910, by Dr Johnson and supraclavicular glands	Recurred 2½ years later in abdomen	May, 1911, inoperable, toxins tried, marked improvement
44	32	1906	?	No	3 years, then sudden increase in size	Scrotal size of grape-fruit	Sarcoma	Operation, Jan., 1906	Recurred in 8 months in retroperitoneal glands, toxins short while, no effect	Death 11 months later, March, 1908, total duration of life, 2 years
45	23	1907	R	No	First noticed March, 1906	Scrotal	Sarcoma	Operation, June, 1906, by Dr J Stanley Brown	Large mass in iliac fossa at time of removal of testis	Grew rapidly worse, death 2 months later
46	19	1896	L	No	1 year	Scrotal	Sarcoma	Operation, Jan., 1896, by Dr Chas McBurney	Toxins begun under my direction, Dec., 1910, no prophylactic	Patient in good health over 3 years
47	Ad	1910	L	?	?	Scrotal	Sarcoma	Operation, Nov 5 1910 (Mayo's clinic)	Recurrence in 1912, in abdomen, toxins begun Sept., 1912; small doses ½ to ⅓ minum	Third operation Feb 31, 1913, abdominal operation, found large inoperable retroperitoneal tumors, not traced
48	15	1913	L	No	Noticed first early 1910, 6 months before operation	Scrotal	Sarcoma, small round-celled	Operation, Jan., 1911, by Dr Williams	Had large inoperable metastasis in abdomen when first consulted surgeon, no glands in groin	Toxins short time little effect, death 1½ years from first symptoms
49	18	1908	L	Yes	No operation, loss, 50 lbs weight 1 year later	Scrotal	Sarcoma	No operation	Dec., 1910 recurrence in groin and retroperitoneal glands	Mixed toxins begun Dec 16, 1910, Dr Coley. Marked improvement May 1 1911, still improving
50	28	1910	L	No	July, 1910 first noticed, in 3 months size of fist	Scrotal	Sarcoma	Operation, Sept 23, 1910, by Dr Donovan, Lewiston Md	Well 2 years, then recurs in supraclavicular glands and lung, no involvement of abdominal glands	Removal of glands by operation, fulguration, mixed toxins, still under treatment
51	28	1911	L	No	Tumor 2 months before operation, no pain	Scrotal	Mixed-celled sarcoma	First operation, Dec., 1912	Abdominal recurrence 3 months later very large abdominal tumors, Nov., 1914	Mixed toxins Nov 1911, 2 months marked improvement, temporary metastasis in lung
52	52	1911	R	No	Noticed 1 month before operation	Scrotal	Round-celled sarcoma	Operation, Feb., 1911		

## SARCOMA OF UNDESCENDED TESTIS

No	Age	Date	Side	Antecedent trauma	Duration	Testes normal or ectopic	Type of tumor	Treatment	Result	Final Remarks
53	37	1908	L	No Tuberculosis left lung 10 years	Operation 10 days after first symptoms (pain)	Abdominal ectopia	Round-celled sarcoma	Operation June 11, 1908 by Dr John B Murphy, size of fist	Toxins begun July 8, 1908, by Dr Coley continued at home	Well over 3 years, then died of recurrence, duration of life, 3½ years
54	12	1906	R	No	Operation 2 months after first noted June 1906	Abdominal ?	?	Presbyterian hospital N Y	Few weeks later multiple recurrence in abdomen. No, 1906 markedly emaciated and cachectic	Death few weeks later, duration of disease 9 months
55	30	1903	P	No (No truss)	Operation 6 months after first symptoms	Inguinal canal	?	Operation Mar 1901 by Dr J K Warren Worcester	Recurrence in groin 1½ years later also in iliac glands	Toxins 6 weeks and X-rays no improvement death Feb 1907
56	22	1908	R	Yes Possible trauma operation undescended testis and hernia 1 year before	First noticed Aug 1908 operation at once	Inguinal	Operation, 1908	Recurred in few weeks in groin and iliac fossa	Third operation	Death in less than a year
57	33	1912	D	No	Operation June 1905	Abdominal, double	Round-celled sarcoma	Both testes removed by Dr Wyeth, June, 1905	Well 2 years, then attack of abdominal colic recurrence	Toxins begun May, 1912 Marked improvement continued 6 months Died January 27, 1913
58	31	1911	L	Yes Operation for undescended testis and hernia year before	Tumor 2 to 3 months before operation	Inguinal	Teratoma type	Operation June, 1911, Dr Friend (Chicago)	July 1911 1 month later, abdominal recurrence, extreme emaciation	Death few weeks later Duration of disease less than 6 months
59	55	1913	R	No trauma	Inoperable when discovered	Abdominal	Sarcoma	Exploratory laparotomy, Feb, 1911	Second operation partial removal hematuria	Rapid growth, toxins, July 1913 6 weeks, no effect, death few weeks later
60	29	1908	L	Had worn truss 5 years ago gonorrhea 8 months before	Tumor noticed 1 month before operation	Inguinal	Carcinoma	Exploratory operation July, 1908, by Dr C L Gibson	Tumor found inoperable, bladder involved	Death shortly after

# CANCER OF THE TESTIS

61	51	1903	L	Injury in childhood	Tumor 1 year before operation	Inguinal size of closed fist	Sarcoma, round-celled	Operation, Dec 3, 1908, by Dr Lihenthal	Toxins, 3 to 4 months as prophylactic	Patient well July, 1914, 6 years later
62	35	1903	R	No injury	Supposed to be appendicitis	Abdominal	Teratoma with sarcomatous degeneration	Operation, July 28, 1904	Toxins begun 2 months after operation as prophylactic continued 4 months	Abdominal recurrence 4 months after operation
63	44	1913	L	No	Clinical diagnosis inoperable tumor of abdomen	Abdominal	Spindle-celled sarcoma	Exploratory operation March, 1913, large inoperable tumor of undescended testis	Mesentery, omentum left kidney involved	Toxins 6 months, marked decrease in size & increase in weight, Nov, 1913 worse death Dec 4 1913
64	Ad	1913	L	No	Inoperable tumor	Abdominal		First operation July, 1913 tumor size of coconut removed 3 weeks later second operation	Impossible to remove tumor at second operation	Extremely rapid growth, entire course of disease less than 3 months

## PERIENTERITIS MEMBRANOSA\*

A FURTHER CONTRIBUTION TO THE SUBJECT OF PERICOLITIS, JACKSON'S VEIL, ETC., IN  
THE LIGHT OF A POST-MORTEM OBSERVATION

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OF NEW YORK

AMERICAN periodical literature of the year 1914 has put us in possession of copious and valuable material bearing upon the question of the situs and significance of the various bands, normal, exceptional and abnormal, that we find associated with the abdominal viscera, notably the intestine

Perhaps, under the stimulus of Lane's publications, Binnie was the first American surgeon to occupy himself, in 1905, with the subject. Jackson was the first one to study the anatomical structure of the membranes found so frequently about the cæcum and ascending colon. After these there followed a long succession of articles from various authors which, though divergent about the interpretation of the formation and significance of these structures, and perhaps just on account of their divergences, threw much desired light upon the matter. It is not my intention to present an exhaustive synopsis of the literature, my object being rather to throw a new and significant sidelight upon the causation of the band-like formations. R. Bland Williams<sup>1</sup> gives us a very comprehensive summary of the various views held regarding the subject.

(1) Lane explains the presence of the normal and abnormal bands that appear in the vicinity of the ileocolic junction and elsewhere by the factor of *traction* exercised by the weight of the intestine in the upright posture upon the suspensory structures. If traction be really a physiological stimulus,—a question that has so far not been approached from the experimental side,—then why do we find a rich variety of membranes in the foetus, in whose case the upright posture can certainly not be urged as a serious circumstance?<sup>2</sup> How can we explain by this theory such facts, as that observed by Bevan, quoted by Eastman and Cole,<sup>3</sup> who having removed the appendix of a patient, and having

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<sup>1</sup> Pericolic Membranes and Lane's Kink. ANNALS OF SURGERY, January, 1914, p. 28

<sup>2</sup> Eisendrath and Schnorr. The Significance of the Jackson Veil. ANNALS OF SURGERY, November, 1914, p. 22

<sup>3</sup> Cole. ANNALS OF SURGERY, January, 1914, p. 41

then carefully noted the absence of any membranes about the cæcum, was compelled to reopen the belly of the same patient a year later, when he found a well developed system of membranes where there had none been before? And the reverse of this has been seen, too, and repeatedly. The sketch herewith presented was made by myself in the post-mortem room of the Mt Sinai Hospital on December 30, 1913, during autopsy done on a female patient (Eva R) who had died of heart failure three days after a smooth and rapid pylorotomy done for carcinoma. The remote cause of death was hypoplasia of the heart and of the entire arterial system. She was a woman of normal stature, externally well developed, but her heart and aorta were no larger than those of a child of nine or ten years. In examining her cæcum and ascending colon we found on the outer side of the gut four very delicate, bloodless and silky white bands, attached on the outside to the parietal peritoneum, on their inner end to the gut on or beyond the tænia, one of them being severed in about its middle, the two ends of the severed bands representing very slender and sharply pointed extremities. Evidently we saw here the last phase of the atrophy and disappearance of a fan-shaped pericolic membrane, that, had the patient lived longer, would have completely disappeared. The evolutionary factor of Lane's theory is absolutely confuted by such a finding as this was, as no permanently formed ligament has ever been seen to disappear. The woman had been a busy housekeeper up to her entry into the hospital, the element of traction had been all the while present, and yet her Jackson's veil was disappearing. Normal structures of considerable bulk may and do sometimes disappear by disuse and atrophy, but this consideration would be utterly inapplicable in this case. Rather may we assume that originally the membrane had been formed under a stimulus persisting for a while, that this irritant condition having disappeared, the effects of the irritation were about to disappear also. "*Cessante causa, cessat effectus*"

(2) Mayo and Cheevers, and Flint of New Haven, assume that most, if not all, of these structures are of congenital origin. I think that this stand-point cannot be successfully maintained in this absolute form. The congenital factor is an important one, and on its presence is based the formation of the entire suspensory apparatus of all the viscera. Certain folds persist normally, they become the suspensory ligaments such as, for instance, support the hepatic and splenic flexures. But to declare that all membraniform or solid bands found about the gut represent forms of arrested development is too dogmatic. It is flatly and successfully contradicted by one good observation such as



that of Bevan's cited before, or mine depicted in the sketch shown to you. What part is played by congenital bands in the pathological process here considered we shall inquire into in a subsequent paragraph.

(3) The third theory by which we may attempt to explain the process of the formation of these bands and membranes, is the oldest one. It originated with Virchow, and has been maintained in America by the diligent work of Pilcher, by myself and by several other observers. It considers inflammation, due to bacterial action, direct by invasion of tissues, or chemical through absorption of biochemical bacterial products, to be the essential factor. Let us see whether the element of infection, or, as Adams puts it, "subinfection," is capable of yielding a consistent and harmonious explanation of all the known facts pertaining to the subject.

First of all, the character of the process is essentially a chronic one. True that we are frequently enough called upon to interfere on account of acute symptoms of obstruction, or because of the presence of a destructive process involving the wall of the gut. Ulcerative perforations or gangrene of the gut wall occur not only in the appendix, they may and do involve any portion of the large intestine, though for anatomical reasons they are more frequent in the blind sac of the appendix than elsewhere. These acute crises, however, if looked into closely and critically, will all be found to be only the last phase of a chronic process that, judged by well-known, palpable, often gross changes in the affected structures, demonstrate to the pathologist beyond any doubt a preexistent disorder of a shorter or longer duration.

When, in 1911, I presented my observations on this matter to the American Surgical Association at its Denver meeting, I laid stress upon a comprehensive and unitarian view of this entire question. It is not a question of local, mechanical difficulty alone, though finally the mechanical disturbance brings matters to a head, as it were, compelling the attention of both patient and medical attendant.

The first fact, well established by numerous observations, is this, that membraniform "adhesions" were and are being observed not only in the cæcal area, but may be found near any focus of acute, but especially of chronic infection. It makes no difference whether the seat of the infection is the intestinal or the genital tract. All surgeons, especially gynæcologists, are familiar with the membranous "pseudo-peritoneal" structures that in the presence of purulent oophoritis and salpingitis envelop the uterus and especially the adnexa, and in the more advanced stages of adnexal disease lumped under the name of "pelvic peritonitis." In these cases I have repeatedly found all the pelvic

contents, including the fundus of the bladder, sealed up, as it were, in the bottom of the pelvis, under a vascular, translucent membrane comparable to a diaphragm. "Cobwebs in the attic of the peritoneal cavity" is more than a picturesque phrase coined by the genial Morris. It actually corresponds to a multitude of forms and variations of newly-formed "adhesions" found about and connecting stomach, pylorus, duodenum, gall-bladder, the left lobe of the liver and the transverse colon.

The indiscriminate use of the word "adhesion" has led to and still is maintaining a great deal of avoidable confusion. There are two kinds of adhesions. One kind is what represents truly and literally the immediate and direct adhesion of an organ to another organ, face to face, surface to surface, without the interposition of a membranous or band-like mass of tissue, such, for instance, as we see in the direct adherence of two coils of gut. They occur where the visceral peritoneum was destroyed or damaged, either mechanically, by the surgeon for instance, or histologically by infection. No Jackson's veil is found in these cases, where the adherent surfaces cannot be separated by the most skilful and cautious surgeon without penetrating into the lumen of one or both of the adherent hollow tubes. It is a curious fact, however, that even these close and intimate real adhesions may disappear in course of time, and under favorable conditions spontaneous liberation of the adherent coils may ensue. Two factors come into play here—one is the elimination of the causal infectious element, the second factor depends upon whether any, and if so how much, of the peritoneal coating of the adherent organs was preserved in its structural integrity. Where all the peritoneum included in the area of adhesion was destroyed, there the adhesion is bound to remain permanent. Where, on the other hand, most of the peritoneal tissues embraced in the adhesion have been preserved, there we find, provided that the causal infection be eliminated, a strong tendency in the peritoneal investment of originally movable viscera to resume its normal characteristics. Here peristalsis will perform the functions of gentle massage and of active locomotion, the interposed layer of inflammatory connective tissue is gradually absorbed, then small hollow spaces lined with the restored serosa will form (the process is known to physiologists under the name of dehiscence, separation) between adjacent visceral surfaces, these will enlarge and become confluent, until finally complete separation is accomplished. Gynecologists know how difficult it is to get a permanent result in ventrofixation. This is due to the tendency above described. I have observed with Dr. Kaufmann a case of complete

separation, after obliteration of the stoma, of the jejunum from the stomach, where several years before, gastro-enterostomy had been done by Dr F Lange

Entirely different from these acutely formed adhesions are the connections between viscera of bands and membranes, such, for instance, as are known under the name of Jackson's veil. Here destruction of the peritoneal surface is absent, the forces producing these bridges of tissue are in their action slow and insidious. A large proportion of these bands remain unrecognized because they do not provoke striking symptoms. Symptoms will appear only where the growing bulk and the retraction and shortening of the fibrous components of these bands begin to encroach upon the lumen of the gut, provoking phenomena of chronic or acute stenosis.

We find further, that the beginnings of this new formation are mostly found at the very site of preexisting normal suspensory bands, such, for instance, as the hepatocolic ligament. This becomes invested by a covering of translucent, membranous tissue, loosely adherent, and easily stripped off the ligament proper, which consists of connective tissue of definite, fibrous organization.

We find that wherever there existed a preformed congenital band, normal or exceptional, this can be readily stripped free from its new-formed, delicate and slightly adherent membranous investment. The disputed question of whether these membranes are preformed or of new formation resolves itself into this, that Jackson's veil may appear anywhere along the gut, and that if it does appear at the site of a pre-existent ligament, it becomes superimposed upon and incorporated with a ligament. There is no reason why such a superimposition should not take place, and in fact it is a common phenomenon for obvious reasons. The process, having begun at any one of these physiological straits of the gut, extends therefrom upward and downward. So we see the membrane extending from the hepatic flexure downward toward the cæcum, often meeting another membrane extending upward from the ileocæcal junction, until the entire segment is buried under a continuous sheet. To this tendency must also be ascribed the formation of the so-called double-barrel shotgun arrangement seen at the hepatic and splenic flexures, and that so often seen between the ilium and the ascending colon.

I have had many occasions to examine especially the hepatic flexure, while operating upon the gall-bladder or stomach. In many instances have I encountered a ligament that was pale, shining with the lucent whiteness of a normal ligament, and covered with normal, non-vas-

cularized and pale peritoneum. But whenever a Jackson's veil was found, the ligament was swathed in the superimposed folds of this membrane, extending mostly downward upon the ascending colon.

It may be said therefore, that looked at in the light of this observation, the seeming contradiction as regards the congenital or acquired origin of perienteric bands and membranes is easily resolved. As to the fundamental cause of the production of perienteritic growths, we unhesitatingly state the opinion that it must be looked for in a disorder of the mucous lining of the gut, and more remotely in the character of the intestinal contents. The normal bands are found in all individuals. Were these preexistent bands alone adequately causal, then we ought to find intestinal disorder in every normal individual. This not being the case, we must look for something else to explain the facts, and here enters the biochemical factor, which comprises the chemistry of digestion and absorption beginning in the oral cavity and ending at the anal vent.

And herein we have, I believe, touched upon the most important etiological factor in this question, a factor the elements of which are very little known and are awaiting the master hand of a great investigator. Our knowledge of the biochemistry of digestion, comprising the rôle played by the glands of internal secretion and the nervous system, is in its very infancy and contains mostly a series of detached facts loosely connected by more or less daring speculation. It is very probable that disturbances of the normal biochemical processes in the digestory tract play the initial and most important part in the production of conditions which nowadays come under the care of physician and surgeon only after having become a chronic disorder. If the part of congenital abnormalities of attachment of the viscera were a fundamentally causal factor in the field under discussion, then pathological disturbances would have to be present in every case where such an abnormality exists. Such, however, is contrary to experience. There are numerous cases in which congenital abnormalities were found in cadavers of patients who never had suffered from any grave form of intestinal disturbance. On the other hand, whenever there is intrinsic trouble of the biochemistry of the intestine, inflammatory changes in preexisting normal or abnormal (non-pathologic) bands are seen to appear, and membraniform, new-formed structures develop adjoining the place of intravisceral disorder. That this is true is proven by such an observation as the following history and post-mortem record.

Mrs. Betty Alexander, aged thirty-eight, housewife, Russian, was admitted to Mt. Sinai Hospital December 8, 1912, with an extensive and progressive ulcerative enteritis of the large intes-

tine, characterized by attacks of obstinate constipation relieved with difficulty by laxatives. There was a continuous discharge of blood, bloody mucus and pus. She had lost much flesh and strength. The attacks of constipation were mostly accompanied by high fever. She was prematurely senile, there being present a well-developed arcus senilis and much emaciation. The lungs and heart were normal, liver and spleen non-palpable, abdomen lax, no tumor could be felt. Beginning at the anus and extending upward in the gut as far as a slender proctoscope would reach, there was a continuous field of irregular deep ulceration, from which islands of intact mucosa were seen to project. Marked contraction of this ulcerated part of the rectum was evident. Much pus and mucus came down from above into the field of vision.

December 17. Colostomy on left side, the gut was divided and both ends of it were fastened into the wound. Undisturbed healing of the wound followed and much relief was experienced. Local treatment of the distal segment with nitrate of silver solutions was begun.

On January 15, 1913, the patient began to complain of wandering, sharp, colicky pain in the belly, fever set in with rises of the temperature up to  $104^{\circ}$  F. No tumor and no erection of the gut was then observed. A few days later pus appeared in the proximal segment of the gut. Evidently an ulcer had eaten into the surrounding tissues, causing an abscess which was discharged into the lumen of the intestine. Then the fever disappeared. This condition recurred several times, and the colicky pains became more and more intense and frequent, being felt by the patient once here, once there, over various parts of the abdomen. The bowels moved easily and regularly. In spite of a carefully regulated diet and the use of medicated irrigations this play continued until February 19, when the colostomy wound was revised in anæsthesia. Several fistulous tracts, leading into abscess cavities were found in the neighborhood of the proximal stoma. They were slit open.

February 26. Profuse discharge of pus from both stomata and from the anus. About that time the colicky attacks became very severe, reminding one of the tenesmus of dysentery. The pains were then mainly in the right side. The pus contained no amœbæ, but plenty of streptococci and the bacillus coli.

March 17. Defecation is regular, but attacks of colic are frequent and severe with visible *peristalsis of small intestine*. Fever remittent, continuous.

March 25. Sudden and unexpected death in syncope,—probably from cerebral embolism. The same day the abdominal viscera were examined.

## PERIENTERITIS MEMBRANOSA

*General* Body of a middle-aged, much emaciated woman Slight rigor mortis In the lower left region of the abdomen, there is an old colostomy opening Both stomata are patent On the outer border dissecting up the abdominal wall, are evidences of abscess formation Both loops of gut are adherent to the abdominal wall and exuding from the distal loop are a few drops of cream-yellow pus

*Abdomen* On inserting the hand in the abdomen, numerous dense adhesions are felt

*Small intestines* Many coils of small intestines are bound together by veil-like adhesions extending from one loop of intestine to another These adhesions have fan-like extensions enveloping the intestine and are vascularized The transverse colon is adherent to the loops of the ileum In several places these adhesions have constricted the intestine, producing very narrow strictures with collapsed gut beyond, and distended gut proximally No ulcerations are present in the small intestine At the points of constriction, the mucosa is very thin

*Cæcum* The cæcum is imbedded in a mass of firm adhesions The appendix is slightly rectrocæcal and presents a dilated cystic tip with a stricture formation

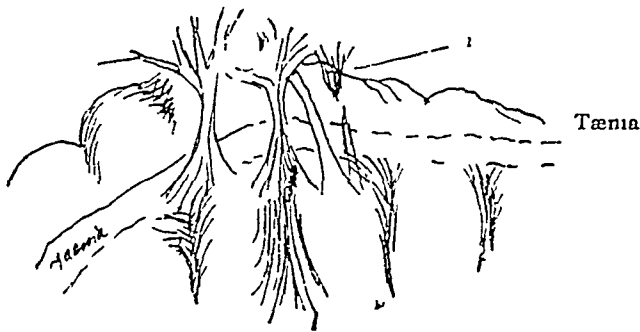


FIG 1—Ascending colon with last vestiges of former membrane a, severed adhesional band

about  $\frac{1}{4}$  inch from the cæcal orifice It measures  $3\frac{1}{2}$  inches in length The tip is dilated and contains about 3 c.c. of creamy yellow, foul-smelling pus The mucosa up to the point of stricture is ulcerated, the ulcers presenting scalloped, irregular edges and slight undermining The cæcum is intensely engorged and congested Ascending, transverse and descending colon present otherwise no abnormality, except for numerous adhesions and vascularized strands which pass across them

*Descending colon and sigmoid* At the junction of the descending colon and sigmoid, the colon has been divided for the purpose of colostomy The proximal loop is greatly thickened, its outer coating being very thick and adherent, in the mesocolon is one small abscess cavity communicating with the proximal loop The mucosa presents numerous longitudinal ulcerations the edges of which are scalloped and the base undermined, the probe passing for several centimetres beneath the mucosa

*Distal loop and rectum* The rectum is firmly bound to the pelvic cavity by means of dense adhesions It is removed with considerable difficulty Its walls are greatly thickened The mucosa presents an irregular appearance There are evidences of old, healed longitudinal ulcers Its normal appearance is completely

obliterated by longitudinal strands extending the entire length of the rectum. The mucosa is absent on both sides of these longitudinal strands, these areas being fibrous and completely healed (see Fig 2)

*Stomach* Is dilated and contains a large quantity of fecoid material. Pylorus is open, duodenum shows no abnormality

*Pancreas* Is rather firm, otherwise normal

*Spleen* Is considerably enlarged, somewhat shrunken. It is pulpy in consistency and markings obscured

*Remarks* —1 It is to be noted that the ulcerative process in the portion distal to the colostomy was found practically healed. Absence of feces and effective drainage with nitrate of silver irrigation must have brought about this change. The ulcerative process above the colostomy had not been checked for obvious reasons

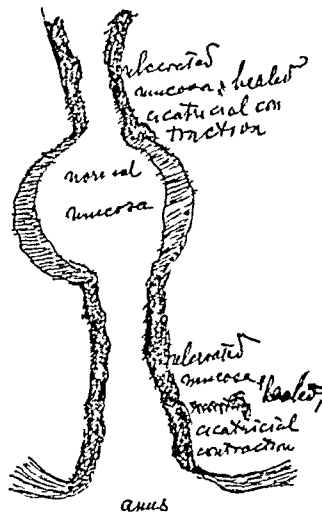


FIG 2 —Formation of ampulla-shaped pseudo dilatation of lumen between two contracted areas

2 The frequent colicky attacks of a wandering character, evidently affecting the small intestine, were due to extrinsic compressive stenoses caused by the bands of recent formation, so numerous found between the coils of small intestine

In Fig 2 can be seen a curious condition of the rectum. You observe that between two extensive areas of ulcerative proctitis, there remained a segment of normal mucosa. When, under the treatment with nitrate of silver, the ulcerated areas had healed and contracted, the intact segment, having preserved its normal lumen, became a sort of distended ampulla.

Fig 3 is a sketch made by myself at the autopsy. It shows a double fan, starting from the posterior parietal peritoneum between cæcum and



FIG 3 —Double fan-shaped membrane between ascending colon and a coil of ileum. Similar veils and bands were found between sigmoid flexure and small intestine and between main coils of small intestines.





ileum and extending on one side to the former, on the other to the latter viscus. Between various coils of the ileum and jejunum similar perienteritic veils were seen to the number of thirty or more. As this observation has demonstrated that membranes may occur not only about the several portions of the large intestine (where, especially about the cæcum and ascending colon, they are most common), but may, in the presence of irritation, develop also about the small intestine, it is proposed to abandon the limiting term of "pericolitis," and to substitute therefor the more comprehensive name of "*perienteritis membranosa*."

The magnitude of the phenomena observed at this autopsy contains the strongest argument in favor both of the inflammatory character of the membranes and the unity of the process. It does not militate against the dignity of the factor of congenital bands, they also may become the seat of an infection proceeding from the mucosa. Thus, by dint of thickening and retraction, they may be converted into a pathological element, their function of physiological regulation of the transportation of the intestinal contents will be augmented and emphasized to a distinctly pathological degree.

Now as to the merits of the whole question, so much may be said. The surgeon has no opportunities to observe the beginnings of intestinal disorders leading to perienteritis. Almost without exception he is called upon only to deal with *end products of a long, pathological process*. The urgency caused by these end products is based either upon destructive changes producing peritonitis, or upon distress caused by obstructive encroachment upon lumen. Without accepting Lane's fanciful pathology we may say, that to him belongs the merit of having made the first attempt at explaining and remedying a condition previously much neglected and unrecognized. His endeavors are directed towards the elimination of organs that have become useless and detrimental. Much more meritorious will be the work of those who will clear up the pathology of the beginnings of constipation, and will thereby prevent the necessity for Lane's heroic surgery.

For those who wish to study the publications that appeared on our subject during the year 1914 the following synopsis is added

January, 1914 1 Pilcher, L. S. Pericolic Membranous Films and Bands  
ANNALS OF SURGERY, 1914, No. 1 Case VIII Band connecting large and small intestine, typhoid origin Case XIV Shotgun arrangement of ascending and transverse colon, bands connecting gall-bladder, duodenum and stomach, appendix and cæcum

January, 1914 2 R. Bland Williams

January, 1914 3 Joseph Rilus Eastman and Albert M Cole A very good study

February, 1914 4 Joseph Rilus Eastman A Further Study of Pericolonic Membranes *Surg, Gynæcol, and Obstetrics*, February, 1914, p 228

August, 1914 5 Joseph Rilus Eastman Experimental and Clinical Studies of Colon Stasis *Journ of the Amer Med Ass'n*, August, 1914, p 441 A meritorious effort This paper was read last June in a symposium before the section of obstetrics, gynæcology and abdominal surgery of the Amer Medical Association, Atlantic City In an extended discussion following the reading of the paper of Eastman, Bonifield, William Mayo, and Chas A L Reed, original views were expressed by Hugo O Pantzer of Indianapolis "Every individual who does not defecate three or more times daily must, in one sense, be regarded as constipated" Read the original!

November, 1914 6 James T Case A Critical Study of Intestinal Stasis, Including New Observations and Conclusions Respecting the Causes of Ileal Stasis *Surgery, Gynæcol, and Obstetrics*, November, 1914, p 592 The importance of the incompetence of the ilio-cæcal valve as a causative factor is insisted on Very interesting

November, 1914 7 Eisendrath and Schnorr The Significance of the Jackson Veil *ANNALS OF SURGERY*, November, 1914, p 622 An excellent and exact study of material, living and cadaveric, the latter both adult and fetal

December, 1914 8 F Gregory Connell The Chronic Abdomen A study of 19 cases in which iliac symptoms recurred after the removal of the appendix, as demonstrated at a second laparotomy A very valuable contribution and worthy of close attention

This list does not pretend to be complete

# THE BONE GRAFT PEG IN THE TREATMENT OF FRACTURES OF NECK OF FEMUR \*

AUTHOR'S TECHNIC

BY FRED H ALBEE, M D , F A C S  
OF NEW YORK

FRACTURE of the neck of the femur is by all means the most disabling of all types of fractures. These fractures were formerly regarded as occurring mainly in old age. Recent personal statistics, as well as those of other surgeons who have large fracture clinics, show a large number of fractures of the femoral neck occurring in individuals below the age of forty-five or fifty. Senile osteoporosis, associated with thinning of the cortex and absorption of many of the lamellæ of the spongia of the neck, is the chief cause of the increased frequency of this fracture in the aged, and, as would be expected, traumata of much less severity cause fracture in the aged more frequently than in younger individuals.

There seems to be no object, so far as treatment or prognosis is concerned, in classifying these fractures further than the single term, "fracture of the neck." The terms intracapsular and extracapsular are inaccurate and misleading. The capsular insertion to the neck of the femur is oblique, thus causing the joint to include more of the neck on its anterior and inferior surfaces than on the posterior and superior. Then, again, most fractures are oblique and diagonal, and are only infrequently strictly transverse. If any classification is used, that of Stimson is by all means the preferable one, *i e*, subcapital, or fracture through the neck, and fracture at the base of the neck. A fracture is apt to occur in one of these two places, either at the junction of neck with head, or with the trochanter. The associated outward rotation in epiphyseal separation or fracture occurs as frequently and is often more pronounced than in fractures of the neck, which fact cannot be explained by the more fragile posterior portion of the neck. The predominance of the external rotators, especially the short trochanteric muscles, is believed to be the more tenable explanation. Shortening depends upon the lessening of the angle between the femoral neck and the shaft or a sliding by of the fragments.

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\* Read before the Philadelphia Academy of Surgery, March 1, 1915

TREATMENT OF FRACTURE OF THE NECK OF THE FEMUR

In speaking of the poor results obtained in treatment of fractures of the femoral neck by the conventional methods, an authority states " At first one can hardly appreciate how startling these results are unless he has carefully studied various series of statistics, and wherever the usually accepted principles of practice are employed, the long side-splints with Buck's extension, there the average results are uniformly unsatisfactory "

Of value in this connection are the conditions existing in 16 cases of fracture of the limb observed by Scudder many years after the accidents " In only 2 cases, or 12 per cent , could it be said that the leg was functionally useful "

Walker studied the records of 112 cases of fracture of the neck of the femur treated in Bellevue Hospital between 1906 and 1907 Only 15 cases, or 13 per cent , recovered good function

The British Fracture Committee tabulated 91 cases, in which 87 of the patients were over fifteen years of age Only 20 of the adults, or 23 per cent , recovered good function

Unquestionably Whitman's abduction method offers better results than the foregoing Certain men, however, have not obtained the favorable results secured by Whitman

Cotton offers the following objections to this treatment " First, many men are inclined to doubt the locking of the upper fragment at the limit of abduction, believing rather that tension on the abductor muscles gives the limit of abduction , second, there is real danger that in less expert hands the fragments may be forced by one another, not jammed together , third, plaster spicas in stout patients do not hold abduction firmly "

At best, fracture of the neck of the femur is one of the most difficult problems in all surgery The anatomico-mechanical conditions, the poor blood supply, the sluggish osteogenesis, and the difficulty of fixation are all potent adverse influences to securing satisfactory union and good functional results, and it is believed that if ever radical measures are justifiable they are indicated in the treatment of this desperate condition Realizing this, certain surgeons have employed the metal spikes to assure better approximation and fixation than could be obtained by non-operative measures This method has not given uniformly good results because of the failure of sufficient callus formation

## BONE PEG IN FRACTURES OF NECK OF FEMUR

An illustrative personal case was that of a woman thirty years of age, suffering from a fracture of the neck of the femur ununited after eight weeks. There was no destruction of the fragments from friction, nor was there any systemic disease to inhibit callus formation. It was a favorable case, and a tin-plated square steel spike, three and a half inches long, was driven into good position longitudinally through the centre of both fragments of the neck, which were in excellent apposition. The convalescence was uneventful. The wound healed by primary union, and at no time was there a temperature above half a degree, after the day following the operation. The operation, however, resulted in failure, and non-union occurred. Fig 8 is a skiagram taken four months after the operation, showing that the spike, owing to its own weight and some destroying influence, had dropped through the lower portion of the capital fragment and no longer engaged it. The metal spike had not only destroyed bone, but it had inhibited callus formation in a region where osteogenesis is at a low grade, to such a degree that it prevented union or, at any rate, was a contributing cause to non-union.

To avoid the disadvantages of metal the author began, in 1912, to use a bone graft peg as a substitute for the metal spike. (For report, see author's report in *Murphy's Clinics*, June, 1913.) If these bone pegs are placed in the cervical fragments by the technic described elsewhere, an equally satisfactory amount of internal fixation is furnished at the same time that the disadvantages of a metallic foreign body are avoided, and the advantages of a living bone graft gained.

A strong autogenous bone peg, accurately fitted into a hole drilled longitudinally through the neck of the femur, with the fragments in good position, offers unquestionably the most ideal condition for the rapid and satisfactory union, in good position, of this difficult fracture. In other words, the influences adverse to union, enumerated elsewhere, are better overcome by this procedure than by any other treatment, also every argument for the autogenous inlay graft in ununited and selected fresh fractures of shafts of long bones holds equally in fractures of the neck of the femur.

Soft tissues are removed, if present, from between the ends of fragments, the fragment ends are secured in good apposition, callus formation is stimulated by the presence of the graft at the same time that the graft produces bone growth itself, and an osteogenetic bridge, capable of conducting both blood-vessels and bone-cells from one fragment to the other, is furnished.

*Indications for Bone Graft Peg in Fracture of Neck of Femur —*  
This operation is believed to be indicated in all ununited fractures of the neck of the femur, in most unimpacted fresh fractures in oper-

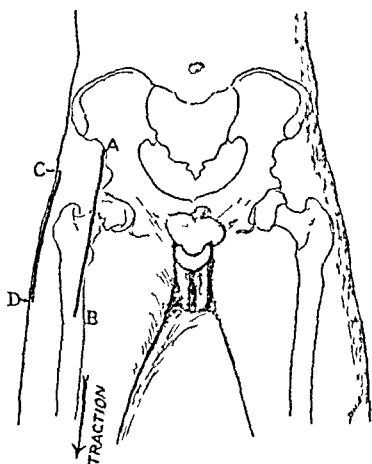


FIG 1 — Drawing representing patient on Hawley traction table A B and C D are skin incisions

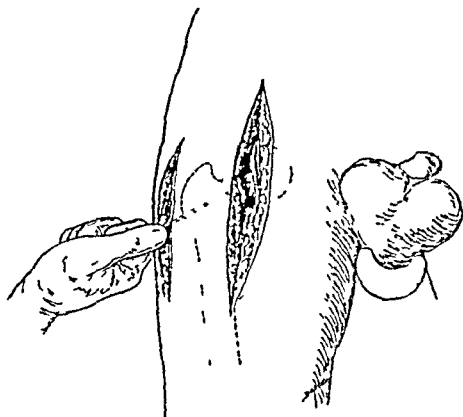


FIG 2 — Drawing to illustrate author's method of determining with small hand drill the proper situation and direction for the motor drill. This hand drill is withdrawn as the motor drill is inserted (see Fig 3)

able subjects under fifty years of age, in all old fractures of the neck or at the epiphyseal cartilage where malunion has resulted, with the neck depressed in a coxa vara relationship with the shaft. The bony

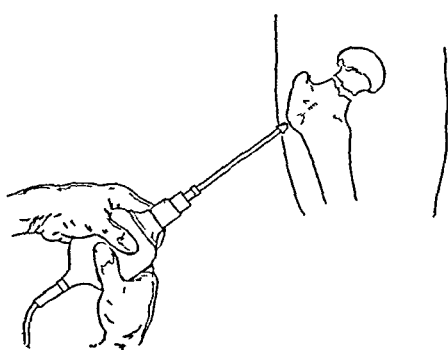


FIG 3 — Insertion of motor drill

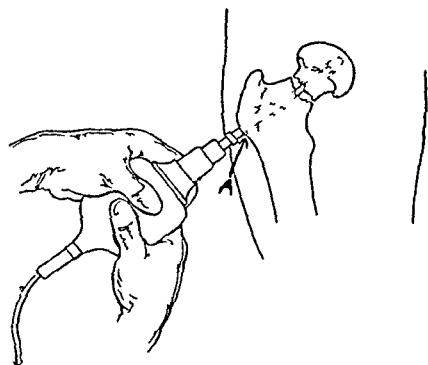


FIG 4 — When the end of the burr has reached the space between the fragments and is ready to enter the capital fragment a reading on the graduated shaft of the burr is taken at A. One is then able to tell just how far the burr should penetrate this fragment

deformity is corrected by either a cuneiform or linear osteotomy, and placing the limb in full physiological abduction (Whitman). After the operative correction of these two latter conditions by the usual

## BONE PEG IN FRACTURES OF NECK OF FEMUR

cuneiform osteotomy, Hitzrot states that weight-bearing should be prohibited for at least a year. The employment of the bone graft peg reduces this time by at least six months.

*Technic of the Author's Bone Graft Peg Operation for Fracture of the Neck of Femur*—A most careful iodine preparation of a wide field for operation should always be carried out. The pubes should be shaved on the day before the operation and the preparation started.

The patient should be placed upon some traction table (Hawley) which will allow, simultaneously, abduction and traction. The point

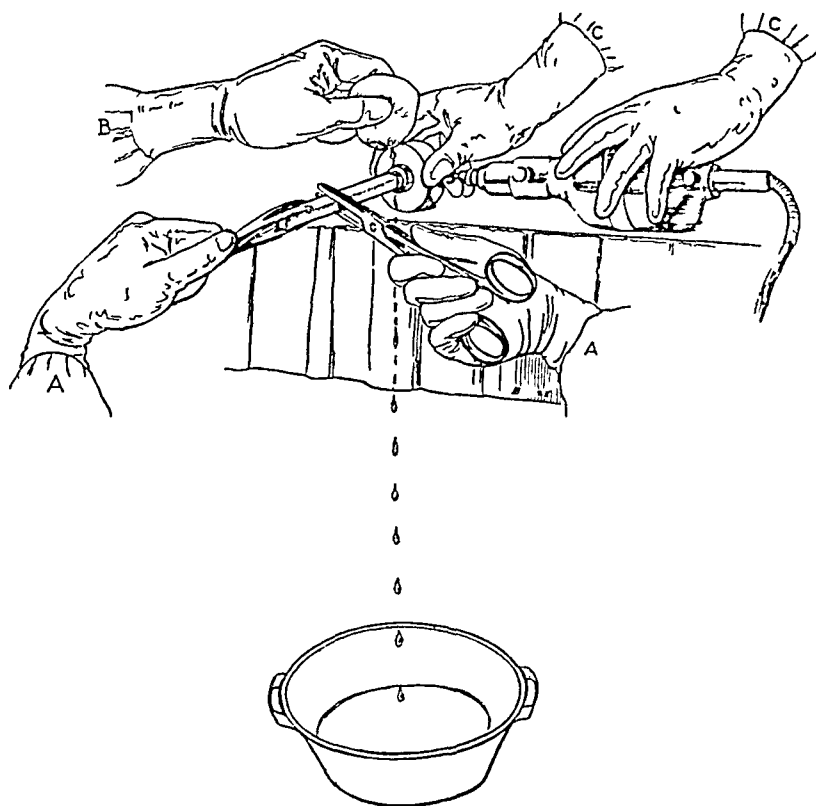


FIG 5 —Graft from crest of tibia being pushed through the author's dowelling apparatus. A A is surgeon, C C, assistant, B, nurse

of fracture is reached by an incision starting from a point a finger's breadth inside of the anterior superior spine and curved downward three to five inches along the inner border of the sartorius. The inner border of the muscle is exposed and retracted outward. The tendon of the rectus femoris is also exposed and retracted outward. The iliopsoas muscle is next exposed and retracted inward. The point of fracture is exposed and all soft tissue is cleared from between the fractured ends, which are curetted and freshened.

The limb is now placed in abduction and sufficient traction applied



to bring the fragments into good apposition as determined by both sight and palpation through the anterior wound. An incision two to three inches long is then made over and just below the great trochanter, which is exposed. With a small hand drill, the proper direction for the motor drill is determined by trial, as shown by observation through both wounds. The drill hole should be situated in the centre of the neck of both distal and proximal fragments, and parallel to the neck. The small hand drill may have to be reinserted in order to locate the proper tract for the motor drill. The motor drill should be held ready by the operator for insertion into the tract of the hand drill as it is withdrawn by the assistant. The motor drill, which forms a hole three-eighths of an inch in diameter, is pushed through the distal fragment until the burr end of the drill appears between the fragments, as

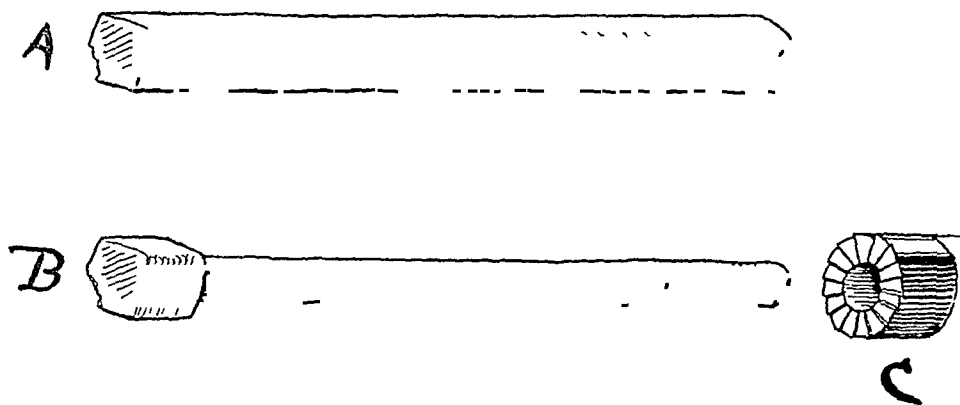


FIG 6 —A is tibial graft. B is graft after being shaped into a peg and is ready to be driven into burr hole in neck of femur. C is lathe cutter.

seen through the anterior wound. Just as the end of the drill is engaging the broken end of the proximal surface, a reading on the graduated drill shaft is taken at its entrance aperture in the great trochanter, so that by making additional readings it can be determined just how deep the capital fragment is being penetrated. By studying the skiagram, the length of this fragment can be very accurately determined, and hence the desired depth of the drill-hole obtained. When the fracture has occurred near the head and the proximal fragment is consequently short, the drill-hole should extend close to the articular cartilage of the head.

The drill is disengaged from the motor and left in place, to avoid any possible displacement of the fragments while the tibial graft is being procured.

The crest of the lower portion of the tibia is laid bare, and an area

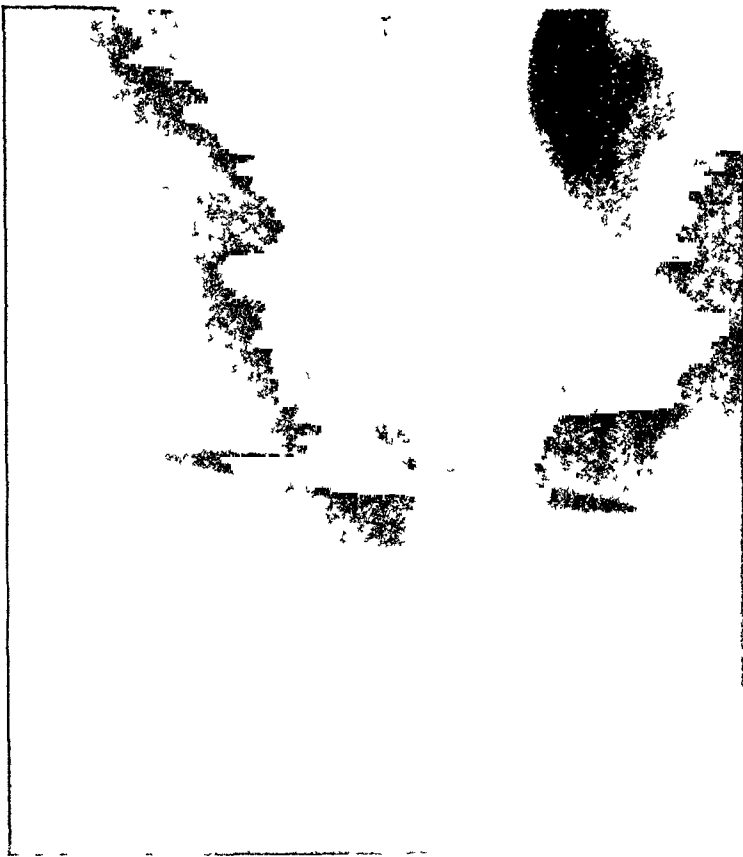


FIG 8—This spike was placed in the centre of head at operation. It has destroyed bone and dropped out of the capital fragment entirely non-union resulting (see text)



FIG 9—1 B is bone graft peg three months after insertion. Firm bony union resulted immediately. It has been six months since operation and the union is firm. The graft is slightly lower than it was intended but did not interfere with the result.



## BONE PEG IN FRACTURES OF NECK OF FEMUR

of the desired size and shape is mapped out in the periosteum with a scalpel. The desired length of graft can be determined by the graduated scale on the motor drill. The cross-section of the graft should be just large enough to be shaped into the peg when the dowel shaper is used.

When the graft peg is ready, the drill is withdrawn from the femur and the peg inserted. The fit must be accurate because the dowel cutter is the counterpart of the drill used. This accuracy of fit is very important. Too tight a fit is undesirable because a pressure anæmia of the surrounding cancellous bone would be produced. Too loose a fit, or an irregular, inaccurate fit, would not produce good fixation or favor an immediate bony union of graft to the host fragments.

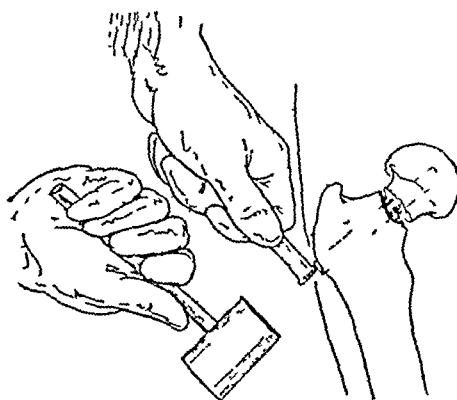


FIG. 7.—Drawing representing graft peg being driven home.

The deep fasciæ are approximated with interrupted sutures of No. 2 chromic catgut, the skin wound is closed with continuous suture of No. 1 chromic catgut.

The limb is put up in abduction (Whitman's position) in a plaster-of-Paris spica extending from the toes to the axilla. Three weeks after the operation, windows are cut in the plaster, and the wounds dressed. The dressing should be replaced with cotton for the purpose of restoring the tension of the plaster splint and retaining the fixation. The long spica should be continued for six weeks and followed by a short one for six weeks longer.

# TRANSACTIONS

OF THE

## NEW YORK SURGICAL SOCIETY

*Stated Meeting, held February 24, 1915*

The President, DR. FREDERIC KAMMERER, in the Chair

### CARCINOMA OF THE RECTUM

DR. J. A. HARIWELL presented a woman, aged thirty-seven years, who had previously been presented to the Society on March 22, 1905 (ANNALS OF SURGERY, vol 42, p 275). This patient was operated upon on May 1, 1904, for cancer of the rectum, which involved the anal segment and ulcerated through into the vagina, which had been the seat of extensive lacerations at the time of childbirth. An artificial anus was performed by the simple method of drawing a knuckle of the sigmoid through the left rectus and passing a tube through the mesentery. Later a radical removal of the cancer was accomplished through a perineal and sacral incision. The patient has remained in perfect health to the present time, and the artificial anus has proved in every way satisfactory. There is one evacuation of the bowels a day, over which she has control, and she has been able to do her work without inconvenience. There gradually developed, however, a prolapse of the bowel by eversion, which was much increased by a severe fall last October.

On February 5 a laparotomy was performed, the prolapsed bowel drawn back into the peritoneal cavity, and firmly fastened by a series of sutures passing through all the coats except the mucosa, to the abdominal parietes. This, apparently, cured the prolapse. At the operation a thorough exploration of the abdomen was made, and there was no evidence of any recurrence of the cancer. The patient is exhibited as a permanent cure of cancer of the lower portion of the rectum which was in an advanced stage at the time of the operation. A point of interest also is found in the demonstration of the satisfactory condition patients may be in, in spite of an artificial anus.

DR. HARTWELL also presented a man, thirty-nine years of age, who was admitted to Bellevue Hospital in January, 1915. He stated that for eight months he had been conscious of some disease in the lower bowel, had been having considerable pain just inside the anus, and has passed blood on several occasions. The disease was apparently progressive.

## CARCINOMA OF THE RECTUM

Examination showed an ulcerated carcinoma about two inches in diameter with markedly heaped up and indurated edges, the lower margin of which was less than two inches above the anus. The growth occupied the anterior and right portion of the bowel, and seemed to have penetrated deeply through all coats so that it was adherent to the structures outside the rectum. There was no evidence of glandular involvement to be made out.

On January 25, 1915, the radical removal of the disease was done by the combined method. A suprapubic incision demonstrated that the growth extended from the seat of the ulcer in a pencil-like cord on the posterior wall of the bowel for a distance of thirteen centimetres upward. This indicated that nothing less than a complete amputation, with a permanent artificial anus, would be of any value. The sigmoid was therefore divided between Peyer clamps, about four inches above the cord-like extension of the growth. The two ends were cauterized and inverted with a linen suture, in the same way that the duodenum is closed in a gastric resection. The proximal end was then drawn through the fibres of the left rectus, and thence for a distance of two and a half inches outward under the external oblique fascia, and then through a skin incision. Here it was anchored without opening. The superior hemorrhoidal arteries were then tied close to the lower segment, the peritoneum divided on either side, and the lower segment freed with all its surrounding fat and tissue as far down as possible. The released portion was crowded down against the perineum, and the inferior peritoneal wall carefully closed. Abdominal wound sutured in layers without drainage.

The patient had been in the Trendelenburg position during this part of the operation. The thighs were now flexed well upon the abdomen, the lower end of the table still being elevated, thus placing the perineum in almost a horizontal plane, and giving an easy access of the parts as far backward and upward as the sacral vertebræ. The anus was then closed with a purse-string suture and its margin burned with the cautery. An incision was carried from the tip of the coccyx forward to within one inch of the anus, which it then encircled and thence passed forward to the edge of the scrotum. The dissection was carried upward, well outside of the anal sphincter, the levator ani muscle cut and all the structures connected with the rectum as far backward as the hollow of the sacrum were lifted forward. A sound was then passed into the bladder. All the rectal and perirectal tissue, laterally and anteriorly, were separated from the urethra and prostate and the dissection gradually deepened toward the peritoneum until the entire

lower segment of the bowel was freed and delivered. At a point on the right side the growth had ulcerated through to the lateral wall of the pelvis, through which some soiling of the parts took place. Aside from this the wounds were entirely aseptic. The peritoneal floor was repaired by drawing the levator ani muscles together, and the superficial structures were then sutured with silkworm-gut, a small gauze drain being inserted to control subsequent oozing. The bowel was opened on the second day, and primary union took place throughout all the operative wounds.

This method of operation proved eminently satisfactory. It gives a complete exposure of all the involved parts, permits of eradication of the disease, leaves the patient with a very satisfactory anus, and is attended with rather less shock than other methods. The time in this case was a little under two hours, fifteen minutes of which was consumed in forming the controlled artificial anus, which, of course, in case of necessity, is not an essential. The Trendelenburg position greatly facilitates the operation, and the subsequent exaggerated lithotomy position, with the foot of the table still elevated, makes the whole operation almost bloodless. Furthermore, it frankly admits the fact that in low lying cancer of the rectum we have no choice except that of forming an artificial anus above. Any attempt to save the sphincter is disastrous.

The specimen removed in this case consists of 18 centimetres of the lower end of the rectum, and all the perirectal tissue, including a small section of the anal skin. At the recto-anal junction there is a crater-like ulcer 5 centimetres in diameter, with ragged, indurated edges, and a nodular indurated base. At the centre of this the growth has involved all the coats of the rectum. The perirectal tissue is composed of fat, showing many lymph-nodes, some of which are infiltrated with the same yellowish-white tissue found in the base of the ulcer. There is a thin cord-like line of induration 13 centimetres in length, situated in the submucous coat of the rectum, on its posterior aspect, beginning at the upper edge of the ulcer and running upward in the direction of the long axis of the gut. The mucosa over the extension of the growth is absolutely normal, and the two are not adherent to each other.

Microscopically, the ulcer consists of neoplastic tissue composed of large branched, atypical, glandular acini, lined by tall cylindrical cells containing elongated oval nuclei. The stroma is abundant and consists of cellular connective tissue, infiltrated with inflammatory cells. Some of the tumor acini also contain desquamated epithelial cells, and polymorphonuclear leucocytes in the form of plugs. A section through the

## TUBERCULOUS PERITONITIS

rectum in the cord-like line, about 8 centimetres above the ulcer, shows a metastasis in the submucosa. There is a metastasis in one of the lymph-nodes in this cord. There was no tumor tissue discovered in the rectum above the cord-like extension. Diagnosis *Adenocarcinoma* of the rectum.

The case is shown as an illustration of what Dr. Hartwell believes to be the proper method of attacking these cases, no other method yet devised meeting the requirements so thoroughly. It also illustrates the very important fact which Handley has emphasized that these carcinomata may extend for a very long distance in the submucosa without involving the mucous membrane, or passing grossly into the perirectal tissues.

## TUBERCULOUS PERITONITIS

DR. FREDERIC KAMMERER presented two cases of tuberculous peritonitis.

The first case was that of an Italian woman of twenty-seven, married, operated upon three years ago. When first seen she had suffered from indigestion for eight years. During the last six months she had had paroxysms of abdominal pain, which had become very severe during the past weeks and which were accompanied by distention of the abdomen and occasional vomiting. She had lost about twenty-five pounds during the last year or two.

Physical examination revealed the presence of a considerable amount of free fluid in the abdominal cavity. Visible peristalsis of the intestine was pronounced. No pulmonary changes. A tentative diagnosis of tuberculous peritonitis was made, which was fully confirmed at the operation done three years ago. A large amount of fluid was evacuated through a median incision at that time, the entire peritoneum, both parietal and visceral, was studded with miliary tubercles. In the lower portion of the small intestine three distinct strictures were found, which gave the impression of small tumor masses lying within the intestinal lumen. There were no adhesions of the intestines among themselves. The general condition of the patient was so poor that it hardly seemed justified to risk further interference, but it was also evident that unless something was done for the intestinal strictures, the prognosis was absolutely unfavorable. Dr. Kammerer, therefore, added two entero-enterostomies, the one towards the stomach incompletely excluding from the fecal circulation about nine inches of intestine in which one of the strictures was situated, the other excluding one and a half feet of gut, in which the other two strictures were found. The patient



made an uneventful recovery and was immediately relieved of her distressing symptoms To-day, three years after operation, she weighs one hundred and thirty pounds, a gain of thirty-seven pounds since her discharge from the hospital

The second case was that of a young woman of sixteen, operated on about two years ago When first seen by Dr Kammerer she had been ailing for three months, after a rather acute onset accompanied by temperatures ranging to  $104^{\circ}$  There was no tubercular family history In the umbilical and right lumbar region a hard nodular, very movable mass about six inches long could be felt, apparently not connected with the genital organs Rectal examination disclosed the presence of similar masses in the abdominal cavity at the level of the promontory Through an incision along the outer border of the right rectus a considerable quantity of fluid was evacuated The tumor proved to be an infiltration of the greater omentum, which latter was converted into a flat mass, from one to two inches thick, its anterior surface having a square shape, with sides six to eight inches long The lower edge of this mass was firmly adherent to the anterior abdominal wall, its upper edge was matted together with the transverse colon The hand could be passed along the left border of the tumor into the pelvis, which contained other hard nodular masses of various sizes The entire peritoneum was covered with miliary eruptions in this case also The abdomen was closed without drainage The patient made an uninterrupted recovery and was discharged from the hospital on May 3, 1913

During June and July she received injections of tuberculin-Rosenbach, which had at that time been so highly recommended by Professor Kausch of Berlin, for the treatment of tuberculous peritonitis, in gradually increasing doses On August 4, the last injection (2 grammes) was given At this time the large mass within the abdomen had almost entirely disappeared and the smaller tumors, which had been felt per rectum, had also decreased in size Although a slight febrile reaction had followed each injection, the patient had gained three pounds during the course of this treatment It should be distinctly stated here that when the injections were begun, a month after the patient had left the hospital, the abdomen presented about the same appearance as on admission The patient spent the latter part of the summer of 1913 at the seashore, where her abdomen was exposed to the rays of the sun for about an hour every day During the winter of 1913-1914 she was again injected with tuberculin-Rosenbach, the course of the treatment being continued for a longer period, and during

## TUBERCULOUS PERITONITIS

the following summer (1914) she again took her sun-baths. No further treatment has been given. As the result of these various procedures, her weight has increased about thirty pounds since she left the hospital. The patient was examined by Dr. Kammerer a few days ago, and also by her family physician. At the present time no trace of any abdominal tumor can be discovered. She is in excellent general condition, although still somewhat anæmic.

Dr. Kammerer believed that the first case presented was evidently an intestinal tuberculosis complicated with a general, and not a localized, tuberculous peritonitis. From the fact that no adhesions were present and the serosa at the site of the constrictions was not more affected than at other parts of the abdominal cavity, it was fair to assume that an ulcerative process within the intestine was in this instance the etiological factor, leaving out of question the primary or secondary nature of this lesion. Resection of the intestine was of course impossible in this case, owing to the low condition and the general involvement of the peritoneum of the patient. But the case shows that incomplete exclusion may give a good result even in the presence of a general tuberculous peritonitis.

It was Dr. Kammerer's opinion that the second case should be classed as an example of exudative and adhesive tuberculous peritonitis. From the course of the case one might infer that no degeneration or suppuration had as yet occurred in the large tumor masses found at operation, as the ulcerative form of peritonitis is scarcely influenced in a favorable manner by operation.

According to our modern conception of a permanent cure, it was too early, two or three years after operation, to speak of the same in connection with the two cases presented. Of the large number of immediate cures (according to some authors 85 per cent.) only about 15 to 25 per cent. remained cured after two years. The speaker disclaimed any intention of attributing a curative effect to the injections of the special tuberculin used in the second case, more especially as the improvement following abdominal incision generally only begins after several weeks have elapsed. It may have been a coincidence, but the rapid disappearance of the tumor-masses in the abdomen during the course of treatment was certainly remarkable.

DR. ROBERT T. MORRIS stated that he had rather come to the conclusion that it was not desirable to remove the masses in cases of tuberculous peritonitis. He had reported two cases, one in which there was a large mass of adventitious tissue surrounding a cyst. In that case several pints of fluid were evacuated, although it was not

recognized as tuberculous fluid at the time. The rise of temperature indicated by the charts, however, suggested the possibility of a tuberculosis, which was confirmed by a positive von Pirquet reaction. The patient was placed upon tuberculin treatment and has been well for some months. In that case only some parts were removed which were found to be entirely composed of adventitious tissue. In the second case the omentum was found to be very largely thickened. This patient has also been treated successfully with tuberculin.

With regard to recurrence of tuberculosis in this vicinity after a considerable lapse of time, Dr. MORRIS mentioned a case already reported in which there was a tuberculous appendix with some tubercular masses. The appendix was removed and the patient made a complete recovery. Within two years, however, she developed a general tubercular peritonitis. This was drained and the patient had then apparently wholly recovered. In another case of tuberculosis of the appendix there was subsequent development of acute general miliary tuberculosis involving both lungs. In that instance the patient had also recovered.

Dr. MORRIS emphasized the fact that subsequent prolonged use of tuberculin was a very important factor in the ultimate cure of these patients.

Dr. WILLY MEYER stated that inasmuch as the clinical pictures of carcinoma and tuberculosis were often closely resembling, the diagnostic value of removing a small piece of tissue (omentum) at the time of operation for microscopical examination could not be too strongly emphasized. He called attention to one of his cases, sent in as tuberculous peritonitis, in which this was done, with the result that the tissue was found to be carcinoma.

#### EXCISION OF BREAST FOR CARCINOMA IN A WOMAN EIGHTY-FOUR YEARS OF AGE

Dr. WILLIAM DARRACH presented a woman eighty-four years of age, who first noticed a mass in her right breast three months before coming to the hospital. This grew rapidly in size and about a week before had broken down in its centre. The ulcerated area had increased in extent and had bled slightly on several occasions. The patient thought that she had lost a little in weight but had not noticed any impairment in her strength. She was a very robust old woman, with good color and marked energy. In the upper portion of the right breast there was a hard, irregular, painless mass with indistinct outlines, which moved slightly on the deeper structures and showed in its

## EXCISION OF BREAST FOR CARCINOMA

centre an ulcerated area with irregular margins and a fungating purplish-red base. The nipple was retracted and was situated just below the margin of the ulcerated area. The skin over the rest of the mass was somewhat thickened with a slight resemblance to pigskin. No axillary lymph-glands could be felt.

On June 17, 1914, the patient was operated upon, being completely prepared before the anæsthetic was started. Gas and ether were used. An elliptical incision was made, passing three inches away from the ulcerated area and the flaps dissected up on each side. The whole breast was then excised with the underlying pectoral fascia, but leaving the muscle intact. The axilla was not attacked. Bleeding points were tied off and the skin closed with silkworm-gut and silk. A cigarette drain was introduced into the lateral portion of the bed through a stab wound in the skin. Dry dressing and binder were then applied. The time of operation was fourteen minutes. The patient was put in a sitting posture in a Gatch bed a few hours later and was allowed up in a chair on the third day. The night after the operation she managed to loosen the bandage sufficiently to scratch the wound. She repeated this on three other occasions during the first three days. On the sixth day a reddened area appeared at the upper portion of the wound and when the edges of the skin were separated a drachm of thick, foul-smelling pus was evacuated. This had completely healed when she was discharged from the hospital thirteen days after operation.

The pathological examination showed a mass six by five centimetres, occupying the whole depth of the breast and apparently involving the pectoral fascia. Under the microscope it was seen to be made up of epithelial cells arranged in an alveolar manner and extensively invading the subcutaneous tissue and the breast. The latter showed marked atrophy with a good deal of connective tissue. The epithelial cells of the tumor in general were of large size with marked mitotic figures. Some places showed degeneration, with pale nuclei and fatty replacement. Near the surface and extending down into the interior there was extensive round-cell infiltration and extravasation of polymorphonuclears. The diagnosis was carcinoma of breast with ulceration.

She was visited six months later by the Social Service nurse who reported that she was in very good health and was going out to work every day. To-day, eight months after the operation she is in the best of health with no local signs of recurrence. She lives on the fourth floor of a tenement and goes to work as a seamstress every

day at eight, returning at four or five. In addition she does her own house work, as she lives alone.

It was Dr. Darrach's opinion that this case seemed to illustrate the wisdom of occasionally departing from the beaten path and breaking some of the rules of surgery. A complete operation with removal of the pectorals and axillary contents seemed to entail too much risk and the simpler palliative operation promised to avoid, at least for a while, the danger and inconvenience of the bleeding ulcerating mass. A similar case was in the ward at the same time and the same operation was done, the woman being seventy-six, but apparently much older than the patient presented. She is still well and free from recurrence. Dr. Darrach emphasized the fact that of course these were both recognized as palliative operations only, with no hope of a prolonged cure, and performed solely for relieving pain or distress and for controlling the important factor of hemorrhage from ulcerating surfaces.

DR. ARPAD G. GERSTER stated that in all his experience he remembered no patient of eighty-four with this condition, the oldest patient suffering from carcinoma that he had observed being a woman of seventy-nine. This patient was brought to him by a young doctor, a zealous new graduate, who had taken charge of her case the day before, had made a diagnosis of carcinoma, and decided that immediate operation was necessary. When Dr. Gerster examined the patient he found that she had no breast, the skin was drawn in concentric folds to the place where the breast had been originally situated, where there was a granulating ulcer about the size of a quarter, in the middle of a deeply retracted scar. The axillary glands were affected and just palpable. Upon inquiry the patient told him that she had had the tumor for forty-six years. He then advised the doctor to take her home and let her alone. This was evidently one of the mildest forms of carcinoma, indicating what enormous differences there may be in the virulence of carcinomata. The patient had acquired the condition when a young woman and went through more than half her life without metastasis. He believed that in this instance operation might have led to death, while abstention from interference may rather prolong life.

DR. JOHN A. HARTWELL mentioned a case of a man, sixty-nine years of age, who had noticed a tumor about the size of a hickory nut in the region of his left breast nine months before. At the time he presented himself at the Bellevue Hospital, there was a growth the size of a large apple, which occupied the whole region of the breast,

## PITUITARY CYST

and protruded outward two and a half inches from the surface of the chest wall. The skin was ulcerated through and the tumor had the color of sarcoma. The tumor was removed under local anæsthesia by the same operation as performed by Dr. Darrach in his case, not removing the muscle, but cleaning out the axilla and taking off the whole breast and pectoral fascia. Microscopical examination showed a very actively growing carcinoma undergoing degeneration.

## DORSAL PACHYMEINGITIS CURED BY LAMINECTOMY

DR. CHARLES A. ELSBERG presented a patient who had been operated upon fourteen months before for a pachymeningitis in the upper dorsal region, the patient having had pain in the back, increasing in severity for four years and increasing spastic paraplegia for one year. Operation revealed a tumor-like thickening of the dura at the level of the first dorsal segment, which caused marked compression of the cord. The affected dura was excised after typical laminectomy and the exposed cord covered by cingulate membrane. Recovery from the operation was uneventful and the patient was presented entirely well. For some months after the operation she suffered from root pains in the first and second dorsal posterior roots, but these disappeared entirely and her spastic paraplegia rapidly disappeared so that she was able to walk around three weeks after the operation.

In reply to a question by Dr. Hartwell as to whether there was any etiological factor in the case, Dr. Elsberg replied that there was a history of some spinal trouble in childhood whose nature was unknown.

## PITUITARY CYST RELIEVED BY INJECTIONS OF POSTERIOR LOBE EXTRACT

DR. CHARLES A. ELSBERG presented a young girl of twenty-three, who had not menstruated for six years and had suffered from severe headaches for three months with marked asthenia and pallor. For three months there had been progressive diminution in vision in the right eye and some diminution of vision in the left eye. There was temporal hemianopsia in the right, and temporal pallor of the left eye. X-ray showed normal sella turcica. The patient left the hospital after one month. She returned a month later with all the symptoms much worse. The vision in the right eye was almost gone.

Dr. Elsberg performed a right subtemporal decompression which resulted in some improvement in the right eye and disappearance of the headaches. The patient was re-admitted to the hospital two months later with all of the former symptoms much aggravated. The head-

life by the observations of Lane, of London, and although it was Dr Pilcher's belief that hardly anyone beyond Mr Lane and his immediate disciples were willing to accept Mr Lane's explanation of them, he felt that Lane ought to be duly credited with having so strongly drawn attention to them

If it was true that the conditions under discussion produced positive obstruction of the ready and normal onflow of the intestinal contents only when they became markedly accentuated, then those more exaggerated conditions found far beyond the embryonic period should certainly be surgically considered. Many surgeons have looked upon these as the result of infections through the bowel wall, diffuse and long continued, and proliferative in their action, and having as their final result a product which in a certain proportion of cases at least positively constricts the lumen of the bowel. Having repeatedly found these constricting bands and crippling films in his work and positively identified them, Dr Pilcher could not avoid the conclusion that their presence was an active cause of the symptoms to relieve which intervention had been necessary. As to the rôle of traction in their etiology, since in every day life in every active person traction was being continuously exerted upon the fibrous structures that hold in place all intra-abdominal organs, he could not accept the theory that simple traction in itself could be the cause of the occasionally occurring fibrous overgrowths that constitute the pericolic films and bands under discussion. As to their possible embryonic origin he called attention to the fact that in almost every case patients had far outlived the conditions which are embryonic before the development of function-embarassment, and hence he had to conclude that while the fact was exceedingly interesting as a study, it had very little significant or practical bearing upon the surgical question. There therefore remained, it seemed to him, as the most rational explanation of the development of these crippling and constricting fibrous sheets and bands, infection transmitted through the intestinal walls due to stasis of the intestinal contents, such infection being the real and important cause of the perienteritic bands with which the surgeon has to deal. It is not to be denied, indeed it is extremely probable, that the final fecal stasis may have been caused by a ptosis or some degree of appendical inflammation reacting upon faulty conditions that had been transmitted from the period of embryonic development.

Dr Pilcher noted the fact that although many surgeons as yet were unwilling to admit that the condition under discussion was a

very important one, he felt from his own personal observations that those who first identified it and those who later elaborated the knowledge upon it, had added a very definite valuable asset to surgery. Furthermore, he felt that as it was recognized and treated more and more successfully, it would be found to be a means of overcoming many chronic disturbing conditions, the treatment of which had too often been a source of disappointment to surgeons.

DR JOHN A. HARTWELL stated that it was a great relief to hear two such able men as Drs. Pilcher and Gerster cast a certain amount of doubt upon the importance of many theories that had been advanced as the cause of this condition, and to learn that in their opinion it was definitely inflammatory. It was his opinion that the clinical importance of the subject originated in a rather blind groping on the part of some surgeons to explain on anatomical and pathological grounds symptoms that were caused by other conditions. To substantiate this belief, he called attention to the cases of tuberculous peritonitis presented by Dr. Kammeier, wherein extensive adhesion formation had taken place throughout the abdomen without producing very great disturbance in the functioning of the intestine. In view of this fact, Dr. Hartwell felt that surgeons were treading on very thin ground when they attempted to assign a definite clinical picture to the delicate Jackson's membrane and dignified it as being the cause of symptoms, or when they attached very great significance to the removal of those veils as being of any great advantage in curing the symptoms which they were supposed to cause. He believed with Dr. Pilcher that only when the band became an actual menace to the mechanical activity of the intestine was it a matter of surgical consideration.

In concluding Dr. Hartwell stated that there was doubtless a double meaning to the statement of Dr. Pilcher that the discovery and lately elaborated discussion upon this subject had been a valuable "asset" to surgery, that it had been a valuable asset to surgeons he had no doubt, but he was not so certain that it had been a valuable asset to our knowledge of the conditions. The hope of finding an explanation for the symptoms and ascertaining whether they might be relieved by the aid of the knife or whether they were caused by factors beyond the aid of surgical interference justified their further careful study and discussion.

DR WILLIAM DARRACH stated that it was his opinion that whether these veils were due to congenital development, to contraction or to inflammatory conditions was not the main issue. They were frequently



found at all events when the abdomen was opened, either for the purpose of discovering them or for some other reason, and he wished to know the custom of Dr Gerster and others when meeting these conditions. With the exception of the extreme cases where conditions had gone on to a point of constriction and interference with the normal flow of the intestinal contents, Dr Darrach believed that such veils were usually present in a purposeful way—probably to anchor and support the large bowel, distended beyond the normal amount by gas or other products of inflammation. The extreme cases he felt called for surgical treatment, but it was a question as to what treatment could be properly instituted for the other cases.

DR GERSTER stated that he had not dealt with this subject from the operative point of view which, though interesting, was relatively not as important as understanding and comprehending the pathology of the process. Surgeons only have an opportunity of visualizing these structures when performing an operation, although many patients with similar conditions never reached the hands of the surgeon because of the non-existence of serious symptoms calling for surgical interference. The utter futility of merely dividing such membranes from the point of view of a permanent cure of the intestinal disorder was demonstrated by their rapid reformation, in spite of a possible temporary subsidence of the symptoms, patients were really not cured by operation, which could do no more than relieve mechanical obstruction. It was therefore Dr Gerster's opinion that the cause of this condition was to be sought in something beyond the formation of these veils, something intra-intestinal which was the cause of their formation. Surgery could relieve mechanical difficulties, and do nothing else, it could not eliminate enteric disorder affecting the mucosa of the gut.

Particular reference was made to Dr Pilcher's remark, that many surgeons to-day did not regard the subject an important one. Dr Gerster stated that when they had once seen a case of obstructive ileus with gangrene of the ascending colon, due to contraction of the hepato-colic band, such as he had seen, then perhaps these surgeons would admit that the subject was important. Dr Gerster stated that when he first read about this subject he also failed to be impressed, but when there had come under his care, both at the hospital and in private practice, cases in which the patient had developed a pain in the right side of the abdomen, with fever, constipation, vomiting and all the symptoms of appendicitis, where a good diagnostician had made the diagnosis of appendicitis, and this same appendix having been removed

was found to be normal, then he began to take note of the condition. It was repeatedly observed that such a patient while upon a diet with bowels kept freely open, felt well. When, two or three months afterwards, he had resumed his old vicious diet he came down again with another "appendicitis," that is, trouble in the right iliac fossa simulating appendicitis. These are the patients who wander from one hospital to another clamoring for relief, operative or other. Their number is considerable. It stands to reason that the removal of the normal or of a diseased appendix cannot effect the cure of a chronic enteritis. We must endeavor to recognize those cases in which there are cæcal symptoms in the presence of a normal appendix. In these the therapy, medical in the first place, surgical only where obstructive symptoms be present, must be directed towards the enteritis.

Dr Gerster further stated that from his first observation of these membranes, he never looked upon them as the cause of the trouble, believing them to be secondary to the intrinsic disorder of the gut. Similar veil-like structures are found about the uterus, uterine adnexa, stomach, gall-bladder and about any portion of the large intestine. In the case related in his paper the entire intestinal tract, the small and large intestine, was invaded by these formations. The causal factor was an extensive streptococcus ulceration of the sigmoid flexure. A low degree of infection (Adami's "subinfection") had evidently involved the entire peritoneal surface, causing Jackson's veils to appear everywhere. Large and small intestine were concerned in the process, and the retraction of several of the veils connecting two coils of small intestine, had led to obstructions of the small intestine, a truly enlightening finding!

Dr Gerster agreed with Dr Hartwell as to the need of further careful study of these membranes. Many cases existed in which for some reason or another very extensive veil formation had taken place without producing serious acute or chronic obstruction. He also accepted Dr Hartwell's remark that the removal of these veils would not effect a cure of the trouble, at best it could only eliminate stenosis due to compression by a retracting membrane. If the surgical procedure is not supplemented with proper internal medical treatment, directed towards the cure of the intestinal disorder of the mucosa nothing will have been accomplished but a piece of surgical "plumbing." In this connection he mentioned the fact that surgeons as well as the general practitioner did not pay to chronic intestinal disturbances the attention they deserved. The complaisant laxative has become a generally accepted and generally abused *pois asinorum*.

*Stated Meeting, held March 10, 1915, at the New York Academy of Medicine*

The President, DR. FREDERIC KAMMERER, in the Chair

CARCINOMA OF STOMACH EXCISION BY POLYA-REICHEL METHOD

DR. ERDMANN presented a man who, after nineteen months of persistent gastric symptoms, was subjected to an exploratory laparotomy by Dr. G. D. Stewart at Bellevue Hospital on December 17, 1913. The report states that a mass the size of a hen-egg was found on the posterior surface of the stomach about an inch and a half from the pylorus and adherent to the pancreas. There were adhesions about the pylorus, the gall-bladder was free and compressible, hæmangioma of liver. The wound was closed without further operation. The patient claimed relief for two days after operation, when he became ill as before and continued to go down hill.

On November 23, 1914, he was admitted to Gouverneur Hospital with the diagnosis of carcinoma of the stomach, thought to be inoperable. Test-meal the next morning yielded two ounces of poorly assimilated food, total acidity 40, free hydrochloric acid 25, no lactic acid, no Boas-Opler bacilli, no blood, macroscopically, microscopically, or chemically.

In December the patient began to complain for the first time of constant boring pain in the epigastrium. He vomited after every meal and could retain absolutely no food. He was very anæmic and emaciated, weighed only 118 pounds, and was losing ground rapidly. There was slight tenderness in the epigastrium and upper abdomen, but no tumor was palpable.

January 2, 1915, Dr. Erdmann exposed his stomach by a transverse incision, five inches in length, across the upper abdomen, extending through all the tissues to the abdominal cavity. The stomach was found to be dilated and extensively adherent to the pancreas and liver. The pancreas was freed by sharp and blunt dissection, the liver also was separated, this being very difficult because of the dense adhesions and pathological changes. All the lower part of the stomach was involved in an ulcer which was thought to be malignant. The pyloric half of the stomach was excised. A rent was made in the mesocolon and the stomach at the excised region was brought through and anastomosed to the jejunum by a double row of Pagenstecher's sutures, by Polya's method. Three or four sutures were taken in the mesocolon and stomach to close the rent in the mesocolon.

## ULCER OF DUODENUM

The patient made an uneventful recovery. On February 19 he was helping about the wards. On March 1, he weighed 144 pounds, had had no return of vomiting, and was gaining in weight and color.

Pathological report of specimen removed at operation: "*Chronic gastritis with early carcinoma*"

## GASTRECTOMY WITH TRANSVERSE COLECTOMY

DR ERDMANN presented a man, twenty-seven years of age, who was admitted to the hospital November 4, 1914. Since January, 1914, he had been the subject of the gradual development of the usual symptoms of carcinoma of the stomach.

Examination revealed a hard, movable tumor in the epigastric region, irregular in outline, situated to the left of the median line and extending to the right of the median line. There was no history of syphilis, nor history of intestinal disturbance. The patient was markedly anæmic and showed evidence of considerable loss of flesh, he claimed to have lost fifty pounds in weight.

November 10, 1914, the stomach was exposed and a large mass including its distal half found present. Very few glands were involved. A mass, the size of a large peach, was in the transverse mesocolon. A transverse colectomy and gastrectomy were done, the colon being clamped off at its splenic and hepatic flexures. After bisecting the duodenum, four-fifths of the stomach were removed with the colon, *en masse*. Owing to the small pouch of stomach left, it was necessary to do an anterior gastro-enterostomy. The splenic and hepatic ends of the colon were severed, and a cæcosigmoidoscopy, with appendectomy, was then done.

The patient was up and about in ten days. Has now gained about thirty-six pounds.

## ULCER OF DUODENUM, WITH ULCER OF LESSER CURVATURE

DR ERDMANN presented a woman, thirty-five years of age, who was first seen by him on December 5, 1914. She gave a history of having suffered from gas in the pit of her stomach for several years, with free and considerable belching, had a sense of fulness or discomfort after meals, relieved by taking soda bicarbonate, no vomiting, had had pains in the pit of her stomach and marked hunger pains for several years, had a desire for food and could eat every ten minutes of the day, no loss of weight, had had some early morning attacks of pain. Examination revealed tenderness on palpation in the right hypochondriac region.

Upon opening the abdomen, February 3, 1915, an indurated ulcer of the duodenum, one finger's breadth, postpyloric, was readily seen. While attempting to deliver the pylorus and first portion of the duodenum, a marked thickening was felt in the posterior wall of the pyloric antrum, near the lesser curvature. The indurated area of the duodenum was excised, and then the pyloric end of the stomach was split longitudinally on the anterior wall, sufficiently to allow inspection of the indurated area on the posterior wall. This was seen to be an eroded ulcer about 1.5 cm long by about 1 cm wide. This was excised and the edges were sutured with two rows of catgut. The gap in the duodenum and pyloric end of the stomach was brought together by catgut and linen sutures, transverse to the long axis, so that the final opening was about two inches long. An appendectomy was then done, and the abdomen was closed. The recovery was excellent and rapid.

#### CARCINOMA OF THE STOMACH WITH LARGE TUMORS

DR. FRANZ TOREK presented patients and specimens of carcinoma of the stomach in which he had done resection for tumors of considerable size. These cases were selected for demonstration in order to show that the large size of a tumor did not offer a valid reason for refraining from the performance of a radical operation. He said that at the present time surgeons were becoming more and more inclined to approve of this stand-point, but that some ten years ago those who resected in cases of large tumors constituted a small minority. In fact, the most widely spread view was, that when a carcinoma of the stomach was large enough to be felt it had ceased to be operable. He remembered very well how, over ten years ago, one of our well-known consultants commented upon an operation Dr. Torek had performed on one of the cases presented this evening as being a waste of energy and prophesied that within a year he would see the inevitable fatal outcome.

The case in question was the first one presented, a woman, now fifty-nine years old. The tumor, previous to operation, manifested itself by a prominent bulging in the epigastrium of the extremely emaciated patient, that could be plainly seen across the room, moving up and down with respiration. Resection was performed on January 2, 1905. The patient was presented before the Section on Surgery of the New York Academy of Medicine, 14 months later, at which time she had gained 45 pounds in weight. The case was published in the *Medical Record*, June 9, 1906. The pathological diagnosis was carcinoma gelatinosum. The patient subsequently gained still more, but

## CARCINOMA OF STOMACH WITH LARGE TUMORS

now her weight is 9 pounds less than her highest figure, owing to the development of diabetes. The speaker called attention to the interesting fact that this specimen, the smallest of the four presented, showed a bulging before operation as prominent and as distinctly visible as the larger ones, and operation had been refused by another surgeon on the basis of its size.

The next case, a male, was operated  $3\frac{1}{2}$  years ago. He had almost absolute obstruction. He has gained some 45 pounds since operation. The tumor, the largest of the four presented, an adenocarcinoma, measures 10 cm. in length.

The next one, a male, now nearly seventy years old, was operated 2 years and 2 months ago. The pathological diagnosis was adenocarcinoma. The indurated area measures 7 cm. in length, the whole specimen 11 cm. At one place in the lesser curvature the peritoneal surface is roughened and nodular. The tumor had grown through the entire thickness of the stomach wall. The carcinoma was firmly adherent to the pancreas. This patient has gained in weight more than any one of the others, his weight now being 62 pounds more than before operation.

The last patient, a female, was operated on December 3, 1913. The tumor, a mucinous adenocarcinoma, measures 8 cm. in length. Like the preceding one, this tumor was attached to the pancreas. She has gained 22 pounds since operation. Besides vomiting of food eaten two days before and other symptoms common to most of these cases she had a symptom usually ascribed to duodenal ulcer, a dull pain in the epigastrium, two hours after a meal, relieved by eating, but the pain was also relieved by vomiting. As in all the other cases a large mass was felt in the epigastrium.

Dr. Torek said he did not enter into the details of the histories as he wished to avoid the reiteration of the description of a familiar clinical picture. It was sufficient to state that the patients were all very much run down, markedly anæmic, and in an advanced stage of starvation, that, nevertheless, the patients were able to endure an operation which in every case was a lengthy one. The shortest, the first one, took  $1\frac{3}{4}$  hours, and each of the remaining ones over two hours.

The choice of resection as an operative procedure, the speaker said, depended not upon the size of the tumor but on the question whether the new growth was sufficiently circumscribed to permit the operative interference to reach well beyond the limits of the disease, removing all the affected lymphatic nodes in connection with the tumor.

The absence of metastases was also a condition for the choice of resection. This was the stand-point he had taken ten years ago. The indication for resection had lately been extended by some still further, and, he believed, with justice, so as to include some cases in which it was impossible to remove all the enlarged lymphatic nodes, the reason being that all of these need not necessarily be themselves carcinomatous.

As regards the formerly oft-expressed opinion that a palpable tumor renders the case inoperable, he wanted to say one word. The more benign, slowly growing, well circumscribed tumors at the pylorus are, as a rule, much more easily palpable than the more malignant cases of diffuse infiltration without a definite boundary line. The above mentioned opinion might therefore be reversed so as to read that *a palpable tumor may offer a better risk than many that are not palpable*. Of course, the roentgenogram will give valuable information on this point.

#### MULTIPLE SYMMETRICAL LIPOMATOSIS

DR FREDERIC KAMMERER presented a case of multiple symmetrical lipomatosis in a man of about fifty years. The speaker had seen four other cases during the past 25 years. They were all employees of brewing companies, who drank from 10-30 glasses of beer a day. The case now presented was one of the variety of circumscribed lipomata. Most of these patients seek surgical relief for the growths about the occiput, neck and shoulders. Several had been operated on and little difficulty had been experienced in removing these masses from the back of the neck and head. Only in one case of rather more diffuse development beneath the chin had dissection been rather troublesome.

#### OSTEOMYELITIS WITH MULTIPLE FOCI

DR CLARENCE A. MCWILLIAMS presented a lad of sixteen years, who, three days before his admission to the hospital on April 25, 1912, had complained of pain in the upper part of the left leg, which came on early in the morning, and was made worse by walking. He went to bed that evening with some fever and headache. There was no history of previous injury, and no wound of foot or leg recalled, no tonsillitis, and no suppurative focus elsewhere. The night preceding his admission to the hospital he was delirious. Temperature on admission 105.4, pulse 108, white blood-cells, 24,000, polynuclears, 85 per cent.

There was a fluctuating tender swelling over the tuberosity of the left tibia. An incision of six inches was made through the periosteum



FIG 1—May 16 1912 Osteomyelitis of ulna

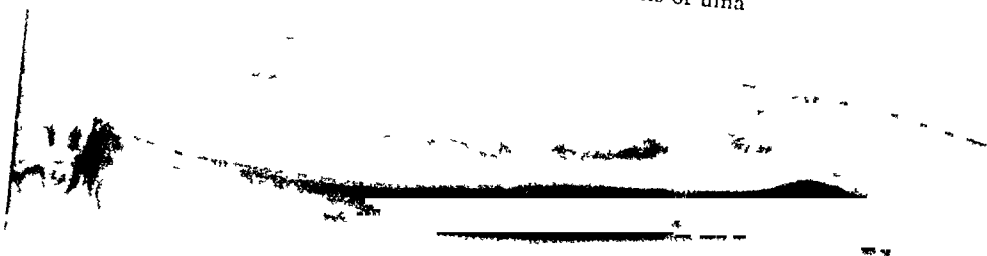


FIG 2—June 12 1912 One month after operation



FIG 3—March 2 1915 Almost three years after operation





into the medullary cavity, from the tuberosity downward. Under the periosteum there was a large amount of pus. Four inches of bone were removed, opening the medullary cavity, which was widely filled with pus and necrotic marrow. The wound was packed. Culture showed staphylococcus pyogenes aureus.

The patient did not improve after this operation. Fluid appeared in the knee-joint, and the leg wound was reeking with pus. Eighteen days later the whole shaft of the tibia was removed, from epiphysis to epiphysis, leaving the periosteum *in situ*. Under the periosteum there was much pus along the shaft. The needle, inserted at the beginning of the operation, obtained turbid yellow fluid from the knee-joint. This showed staphylococcus aureus, the same as in the bone. Autogenous vaccines were made from this pus and administered every other day. After the second operation the patient improved.

Ten days after the second operation, considerable pus was evacuated from over the sacrum. Two weeks after the operation, a large abscess was opened in the left forearm, both containing staphylococci.

The knee-joint was aspirated frequently, but the boy's condition became slowly worse, and he lost ground. Staphylococci were found in both the urine and blood, and urotropin was given.

On April 5, three weeks after the last operation, the knee-joint was drained by two incisions, under gas anæsthesia, and a large amount of very thick pus was evacuated. The patient's condition became progressively worse, and four days later (April 9), to save his life, an amputation was performed through the lower part of the thigh, the sciatic nerve being cocaineized before it was divided. The periosteum was separated from the bone before the latter was divided. The soft parts in the stump were œdematous.

Improvement was immediate, and the patient went home on April 25. The sinus on the left forearm was still discharging.

Three weeks later (May 16, 1912), the patient was readmitted, with much increased inflammation and swelling of the left forearm. The X-ray showed that the disease involved two-thirds of the bone of the left ulna. There had been no difficulty in using the arm, no loss in weight, nor fever.

On May 17, 1912, subperiosteal resection of the middle two-thirds of the entire diameter of the ulna was done. Recovery from this was prompt. Readmitted one month later (July 16, 1912), X-rays had indicated a progressive osteomyelitis of femur. This was operated upon. The periosteum was soft, thick and gelatinous. The bone beneath was soft and rough. Bone cortex chiselled away, opening medullary cavity.

Medulla found vascular and necrotic. Several small sequestra removed. While in the hospital X-rays were taken of all the bones. All were negative except the right humerus, which showed a slight periostitis of middle of shaft. The boy has made a perfect recovery. No further bone lesions have developed. The ulna has regenerated a fair shaft but weak, an ununited fracture in its lower part. Pronation and supination are almost perfect. That forearm is slightly weaker than the opposite one.

#### RESECTION OF THE STOMACH FOR CARCINOMA

DR JOHN DOUGLAS presented a woman, fifty-two years of age, who came under observation on April 11, 1912. She complained of having had stomach symptoms for the previous two years.

Physical examination revealed a mass seven or eight inches in diameter, in region of umbilicus, which moved up and down on respiration. Gastric analysis shows no free hydrochloric acid, no lactic acid, no blood. X-ray examination showed carcinoma of pylorus.

Operation (April 19, 1912). Between one-third and one-half of the stomach was removed by the Billroth No. 2 method.

*Pathological Report*—Scurhus carcinoma of the stomach, enlarged lymph-nodes not involved.

The convalescence was normal.

At the time of presentation, within one month of three years since operation, the patient is in good health, and is up to her normal weight. Dr. Douglas called special attention to the absence of any evidence of recurrence for almost three years after resection, notwithstanding the long history of the presence of a mass before operation.

#### MELANOSARCOMA OF SHOULDER AND NODES ABOUT SHOULDER WELL AFTER INCOMPLETE OPERATION

DR FRANK S. MATHEWS presented a man, forty-five years of age, who when first seen presented a pigmented mole over the middle of the scapula. This, the patient said, had always been present, but had recently increased in size and had been uncomfortable when he leaned back, putting pressure on it. There was noted a fulness above the corresponding clavicle and a large mass of axillary nodes. The mass was about the size of a small fist, was freely movable, and some of the nodes were at least as large as hickory nuts. Because of the well-known malignancy of melanosarcoma and that metastases had already taken place, Dr. Mathews considered the case a hopeless one. Nevertheless, he removed the mole, and through an axillary incision about three

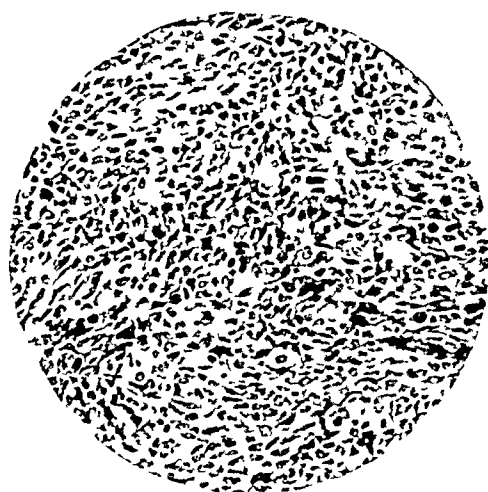


FIG 4 —Photomicrograph of tumor



FIG 5 —Gross appearance of melanosarcoma



## MELANOSARCOMA OF SHOULDER

inches in length grasped the main mass of nodes and removed them. No operation was done on the supraclavicular swelling, and the operation on the axillary region was not in any sense a complete dissection of the axilla.

The skin tumor was distinctly pigmented, but the axillary nodes were macroscopically free from pigment. The pathologists who saw the section at the time called the case one of melanosaicoma, and it presented the clinical characters of that tumor.

Immediate return was confidently expected, with death in a few months, especially as the progress had been rapid, the growth of the axillary nodes (to fist-size) had been noted but five weeks.

The patient now, two years after the operation, appears to be well. There is no fulness above the clavicle, no recurrence at the site of the mole, no abnormal physical signs in the chest. There is a node the size of a hazel-nut to be felt in the axilla. The man has been at work as an engineer ever since the operation.

Dr Mathews said he had heard of melanosarcomas of the eye which have not recurred in the liver until several years after removal of the eye, but in the present case dissemination had already occurred at the time of operation, and the microscopic examination left no doubt of the character of the primary and secondary growths.

*Report of Dr Francis Carter Wood on the Specimen*—Path No 8313. The primary tumor consists of a small pigmented mole, measuring only about 2 mm in thickness and 5 mm in length. The deeper tissues are not invaded by the growth.

The mole itself shows evidence of malignant change. It is composed of masses of large cells cut off by irregular trabeculae of epithelium. Between these cells there is an abundance of lymphoid tissue. There is a moderate number of pigment-bearing cells scattered throughout the tumor. The tumor cells themselves contain numerous mitoses and are large and irregular, with nuclei containing an excessive amount of chromatin. Diagnosis is melano-epithelioma.

The axillary tumor corresponds in its morphology with the pigmented mole. It is composed chiefly of spindle and oval cells with large hyperchromatic nuclei, many of which contain mitotic figures. The tumor is well vascularized and almost no pigment is present. The tumor cells are diffusely invading the surrounding connective tissue and the growth has every appearance of an extremely malignant neoplasm of the type commonly seen originating in congenital moles. The number of mitoses may be estimated from the fact that in one field of a high objective three or four division figures are often found.

It was not suggested that the case was cured permanently nor was there any explanation offered of the prolonged immunity from recurrence.

DR ALEXIS V MOSHCOWITZ said that such cases are likely to

surprise one at almost any time. He recalled a case in his service where a young woman was admitted to the hospital for a pigmented tumor which she had had for a number of years, just above the mons veneris. The tumor could not have been larger than the end of the finger, and though it had existed for years without giving trouble, just before admission to the hospital it became ulcerated. It was excised widely, and after the usual laboratory argument as to whether it was melanocarcinoma or sarcoma, it was decided in favor of the former. There were no palpable glands in either groin.

Later, she returned to the hospital, and at that time there was noted in the right femoral region a very hard tumor the size of an egg, and two small tumors at the inner side of the femoral region extending beneath Poupart's ligament. These tumors were extirpated and found to be melanocarcinoma. They were thoroughly pigmented. The prognosis is exceedingly precarious.

DR EUGENE H. POOL referred to recurrence after melanosarcoma of the eye which Dr. Mathews mentioned in the report of his case, and cited an experience of his own about seven years ago. A woman was admitted to the French Hospital for a tumor in the breast, she gave a history of having had an eye removed five years previously. There seemed, however, to be no connection between the eye and the breast, the tumor of the breast presented the physical signs of carcinoma. Accordingly, a complete operation was performed. Transection showed a tumor extremely black in color which proved on microscopic examination to be melanosarcoma. He then looked up the literature of the subject, and found that in a large proportion of the cases of melanosarcoma originating in the uveal tract metastatic growths are of late occurrence, often from five to seven years after the enucleation of the eye for the original growth, also that when metastases become evident their growth is usually extremely rapid. These two features were illustrated in his case. The growth in the breast had appeared only a few months before the breast operation which was five years after the enucleation of the eye. In spite of a radical operation general metastases developed and the patient died in six months.

DR FREDERIC KAMMERER recalled a case of melanotic tumor of the labium majus, which he had removed many years ago, where no enlarged glands were present in the groin. He had followed the case for a year and a half after operation, with no recurrence. Of another case, which occurred in a young physician, Dr. Kammerer said he did not remember where the primary tumor was located, however, a short time after extirpation metastatic deposits appeared in the lymph-nodes.

## CARCINOMA OF THE STOMACH

and the skin of the entire body. He then removed a large mass of glands in one axilla for the relief of severe pressure-pains. These glands were very much pigmented like the original tumor. The patient died a few months later. The speaker said that in the cases he had seen the metastases in the lymph-nodes were always pigmented and then the case had followed a rapid fatal course.

## CARCINOMA OF THE STOMACH

DR GEORGE WOOLSEY read a paper with the above title, for which see page 22.

DR JOHN F ERDMANN said that there were several points in Dr Woolsey's paper to be considered—one of them being the question of posterior gastro-enterostomy. In these conditions of the stomach he had always felt that, if one could do a posterior gastro-enterostomy, a gastrectomy is also possible (provided the patient's general condition will allow), on the grounds that the stomach must be rotated and brought through the transverse mesocolon, hence the stomach is then sufficiently movable to allow of resection.

In regard to age. Dr Woolsey's cases all occurred in patients over thirty. Dr Erdmann said that out of 43 resections he had had four that were under that age—one 27, two 28, and one 29 years of age.

In regard to metastases. The boy who had been presented had metastases—a metastasis the size of a small peach was in the transverse mesocolon. The stomach was quite movable, and the tumor was movable. It seemed policy to remove it even with the metastases, and in the face of the high mortality in resections of the transverse colon when associated with resection of the stomach.

Dr Erdmann then told of a patient who presented himself last summer, with a distinct history of carcinoma and also some evidence of ascites. The family requested that something should be done. It was a typical case in which to do a resection, except for general peritoneal carcinosis—one metastasis, the size of a large pea, being in the meso-appendix. The stomach was removed in face of multiple metastases in the peritoneal cavity. The man is living to-day and in fine condition—having gained forty pounds. He hoped to have one of those spontaneous recoveries, as seen in the papillo-cystomata of the ovary.

DR JOHN DOUGLAS inquired concerning the ultimate result in the 13 cases Dr Woolsey had operated on. The statistics obtained from different authorities differ greatly. All are familiar with the statistics from the Mayo clinic, of 33 per cent without recurrence at three years and 25 per cent at the end of five years. Friedenwald writes of 1000



cases of gastric carcinoma, only 28 per cent of which were operated upon. Of these 57 per cent were exploratory, and only 3 per cent, or nine cases, had a partial gastrectomy, none of which was still alive at the time the report was made.

Dr Douglas said that he had 8 cases of resection for carcinoma of the stomach, of these, one was still alive two years and eleven months after operation, the longest, another, two years and six months, and a third, two years and three months after operation. The last patient was thirty years of age, with a carcinomatous degeneration of a gastric ulcer.

Dr Moschcowitz thought that Dr Woolsey was properly conservative in stating that he hoped for earlier diagnosis of carcinoma of the stomach with the aid of the X-ray, and said that he shared the doctor's views, but his own experience up to the present time led him to regard X-ray evidence as merely confirmatory. At present he relies mainly on examinations of the stomach, and is in the habit of dividing the work into four groups. First, and of great importance, the history of the patient, second, the physical examination, third, the so-called laboratory examinations—test-meals, the presence or absence of hydrochloric acid and lactic acid, etc., fourth, and last, only the X-ray examination. Of course the X-ray is an exceedingly valuable aid, but only confirmatory, and in most instances the diagnosis can easily be established by the first three methods of examination. He could not recall any case in his experience where he had depended on the X-ray diagnosis and had operated on that authority only and not by the other findings.

His longest case of resection of the stomach was that of a woman reported some five or six years ago, who had two-thirds of the stomach resected for sarcoma. The patient is perfectly well to-day.

It is greatly to be regretted that so much of the material that we work upon has to be treated by exploratory laparotomy and gastro-enterostomy on account of stenosis. Most of the material that comes to Mount Sinai and the other hospitals is very poor, and probably not more than 10 per cent of all the cases of carcinoma of the stomach that come to operation are in an operable condition, not to speak of curing them. He had that afternoon operated on a young man of thirty-six with a palpable tumor. The diagnosis was made, and exploratory laparotomy revealed a tumor of the pylorus, a carcinoma, and a separate and distinct tumor in the pancreas.

Dr Moschcowitz said that he believed only those cases are curable in which all of the diseased tissue can be removed in one mass.

## CARCINOMA OF THE STOMACH

DR KAMMERER said that doubtless all would agree with what Dr Moschcowitz had said about the character of these cases in hospital practice. As the longest period after resection of the stomach for cancer, during which he had been able to observe a patient and note freedom from recurrence, he mentioned five years. This was in a man of about fifty years. The tumor was one of the largest he had ever operated on, two-thirds of the stomach being removed. When last seen, there was no sign of a recurrence. All the other cases which he had been able to follow had died, excepting those operated on during the past two or three years. No doubt these poor results were, as had been said, due to the fact that most cases of cancer of the stomach still reach the hospital surgeon when the disease was very far advanced. He had operated on four patients under thirty years of age, all of whom had died soon after operation, and he wanted to emphasize the great malignancy of these cases in early life. He had operated successfully on cases with a percentage of hæmoglobin as low as 25 and had never been compelled to resort to transfusion. It is astonishing how well these operations are borne even with such an extremely low hæmoglobin count.

Dr Kammerer said that he did not believe that the X-rays could always determine the operability of these tumors. A few weeks ago he had been able to remove a large cancer of the stomach in a case in which the X-rays had given the impression of an inoperable tumor.

Dr Kammerer believed that gastro-enterostomy is indicated where a stenosis at the pylorus has developed and there are reasons for not doing a resection. Such patients can live for years, as we all had experienced. But no doubt everybody would agree with the reader of the paper that resection should be done in preference to simple gastro-enterostomy, whenever the same was technically possible, even in the presence of lymph-nodes which could not be removed. The speaker had always done posterior gastro-enterostomy. If this was impossible, owing to adhesions or involvement of the posterior wall of the stomach, the anterior, long-loop operation had given him excellent results. This should, however, always be combined with an entero-enterostomy in the speaker's opinion.

DR TOREK said that to the number of cases in which a gastro-enterostomy is indicated we should not forget to add those in which there are metastases in the liver or elsewhere in addition to the obstructing tumor of the pylorus. Some of these do very well for a long time. He had operated on a patient six months ago with a large

metastasis, doing a gastro-enterostomy, and the patient is still very happy and grateful

In respect to carcinoma of the cardia, Dr Woolsey had stated that we have as yet no method of operating Volcker had operated on carcinoma of the cardia in 1907, and Kummel in 1909, and both operated by the abdominal route The former sutured the œsophagus to the stomach after resection of the tumor, and the latter made a partial suture over the two arms of a T-tube, the leg of which was brought out through the abdominal wound for feeding purposes Zaaier, in 1913, operated by a combined abdomino-thoracic method in three stages, the first being a gastrostomy, the second stage was the resection of the lowest 7 ribs on the left side in order to cause a collapse of the chest, the third stage was the excision by the combined abdomino-thoracic operation, the incision being made through the abdomen, thorax, and diaphragm

Dr Torek said that his own method, which he had worked out two years ago on the cadaver, and which is published in Johnson's *Operative Therapeutics*, was also a three-stage method first a gastrostomy, second, the removal of the œsophagus from the thorax by his own method and its subcutaneous implantation, and the invagination of the lower stump of the œsophagus into the stomach, third, the resection of the stomach by the abdominal route He had not had a suitable case on which to test the method Ach's method of resecting the cardia is as follows The œsophagus, after ligation and division above the tumor through the abdominal route, is removed, without opening the thorax, by invaginating it The lower end is tied to a flexible steel rod introduced through the mouth, and with its aid the œsophagus is drawn up into itself Through an incision previously made in the neck it is again evaginated Ach operated on a patient in this way and kept him alive for sixteen days

# TRANSACTIONS OF THE PHILADELPHIA ACADEMY OF SURGERY

*Stated Meeting, held March 1, 1915*

The President, DR JOHN H GIBBON, in the Chair

## SPLENECTOMY FOR GUNSHOT WOUND

DR THOMAS F MULLEN (by invitation) presented a colored man, twenty-eight years of age, who was brought to the Pennsylvania Hospital at midnight of January 6, 1915, one-half hour after having received a shot wound from a thirty-eight calibre revolver, in the hands of a man standing a few feet distant. The point of entrance was in the left mid-axillary line on a level with the tenth rib, which was comminuted. The patient was in profound shock, temperature 96°, pulse 160, respiration 48, the abdomen was diffusely tender and rigidity was marked, especially on the left side. On percussion, there was shifting dulness in both flanks. The abdomen was opened, beginning twenty minutes after admission, incision was made at the margin of the left rectus, and later enlarged by dividing the muscles transversely to the left, for a distance of three inches. Upon opening the peritoneum, there was a gush of dark fluid blood which, after packing off the intestine, was seen to be flowing from the region of the spleen. The spleen was grasped and lifted into the wound. It was found that the bullet had passed through the upper pole of the spleen, downward and backward, severing the vessels of the pedicle, which was clamped and ligated *en masse*, with catgut. Gauze drainage was instituted and the wound was hurriedly closed, as there was no apparent injury to any other structure. At the close of the operation, the pulse was imperceptible and twenty ounces of normal salt solution were given intravenously. The patient reacted quietly and vomited once during the following day. The drains were removed on the fourth day and the wound appeared to be clean. From this point his convalescence was uneventful, with the exception of a severe chill which occurred on the twenty-sixth day after operation, and was repeated on the twenty-eighth and thirtieth days. An examination of the blood at this time revealed, in fresh and stained specimens, many malarial organisms of the tertian type and the symptoms promptly disappeared after the

use of quinine On the third day after operation, examination of the blood showed 48 per cent hæmoglobin, 2,430,000 erythrocytes, 15,000 leucocytes, on the eighth day, 50 per cent hæmoglobin, 3,160,000 erythrocytes, 20,000 leucocytes, on the sixteenth day, 50 per cent hæmoglobin, 3,230,000 erythrocytes, 22,000 leucocytes, on the twenty-fifth day, 53 per cent hæmoglobin, 3,928,000 erythrocytes, 15,000 leucocytes, on the thirty-fifth day, 70 per cent hæmoglobin, 4,000,000 erythrocytes, 15,200 leucocytes The erythrocytes were normal in size and shape Skiagraph showed the bullet lodged just anterior to the transverse process of the first lumbar vertebra on the left Patient was discharged on the thirty-fifth day after operation as cured Since his discharge he has been working at his usual occupation and appears to be perfectly normal

#### RUPTURE OF THE BICEPS MUSCLE

DR GWILYM G DAVIS presented a man who ruptured the long head of his left biceps muscle, approximately seven weeks ago, in lifting a bag of coffee weighing 130 pounds The man says he had pain in the shoulder before he injured it, although there is no other distinct history of rheumatism He had the typical swelling below An incision was made along the edge of the pectoralis major, the long head, which was ruptured clear up into the joint, was pulled down, and brought over to the short head of the biceps muscle, which is attached to the coracoid process Chromic catgut was used for the suture The wound healed nicely He now flexes and extends his arm perfectly The operation presents no especial difficulty, except that it is rather hard to draw back the pectoralis major muscle sufficiently to get a good exposure This was the second case in which Dr Davis had operated

DR JOHN H JOPSON said that he had recently seen a case of this injury with a most unusual history The man was a railroad engineer who in July, 1913, slipped in getting out of a boat and fell a short distance, striking his shoulder against the edge of a railroad tie The injury was followed by some ecchymosis but there was no marked trouble with the arm for some time It was not until months later that he suffered much pain, and when he did go to a hospital, more than a year after the injury, he was told that he had a rupture of the biceps muscle Meanwhile he had been working steadily at his occupation as an engineer He was operated upon by Dr Gibbon but he still presents some of the characteristics of rupture of the biceps, in the way of bunching up of the belly of that muscle and on flexion of the forearm, and he complains of pain and disability in his arm with

## BONE GRAFT PEG IN THE TREATMENT OF FRACTURES

tenderness, just below the acromion process, between it and the head of the humerus.

DR JOHN H GIBBON said that he recalled very well the case referred to by Dr Jopson and particularly the history of the man. It illustrated the point remarked upon by Dr Alexander in the paper which he read before the Academy, that the history of not knowing that the rupture had occurred was not an unusual one. Some of the men in Dr Alexander's series apparently did not know that they had ruptured their biceps and had gone ahead with their work, and the correct diagnosis was not made for some months afterward. In the case which he operated upon he sutured the ruptured tendon to the other tendon. The man had excessive blistering from iodine on the inner side of his arm, and from these infected blisters the wound became infected, so that they did not get a very good result. Some time after healing of the wound he developed much pain in the region of the deltoid. He had been at a loss to understand why he should have had it. It was thought that possibly a nerve was involved but there was no atrophy of the deltoid. The man was asked particularly whether he had this pain in the shoulder before his operation and he stated distinctly that he had not.

## BONE GRAFT PEG IN THE TREATMENT OF FRACTURES

DR FRED H ALBEE (by invitation) read a paper with the above title, for which see page 85.

DR JOHN H JOPSON said a word in defence of silver wire in certain locations. He had used it in fractures of the patella and of the olecranon for years, and had never had occasion to take it out of either of these locations, and had never seen it give any trouble. He had never seen it break unless there had been a re-fracture of the part. It may be, as has been long taught, that the chemical action about silver in the tissues is different from that of other metals. When silver plates have been used and required removal subsequently, it is often found that it was the plated or steel screws rather than the silver plate itself that caused the trouble. In the case of one young woman upon whom he had operated for ununited fracture of the tibia and from whom he had to remove the plate years afterward, it was found that the abscess had originated around the screws, which were rusted. The silver plate had caused no irritation. It was firmly embedded in the tibia, which had to be chiselled away before it could be taken out, after removal of the screws.

DR WILLIAM L RODMAN said that he had had very excellent

results with silver wire in fracture of the patella and elsewhere. One case operated upon fifteen years ago is still in good condition. He had also had good results in the use of plates, particularly the plate of Dr. Estes, of Bethlehem. But he believed that plates of all descriptions were for the exceptional, not the average, case and that the very frequent use of plates now in vogue was hardly necessary. In many cases the plates do harm.

DR. CHARLES F. NASSAU said that he had used silver wire in fractured patellas for many years without being obliged to remove it because of any trouble for which it was responsible. He believed that silver wire in the tissues is harmless. It may be recalled that for a time abdominal incisions were closed with silver wire, in fact, during the first seven years of his operative work in Philadelphia, he closed every abdominal incision with silver wire—even after operations on such cases as pus-tubes—and was obliged in two cases only to remove the wire. This is not a large percentage in seven years. In one of these cases, three of the six sutures were removed, and in the other case, all the sutures had to be removed because the resident had introduced a probe into the wound within 48 hours after operation. He did not recall, at this moment, ever having removed a silver wire after operation upon a simple fracture. In compound fractures, of course, subsequent removal of the wire is frequently necessary.

DR. PENN. G. SKILLERN, JR., recalled the classic comparison between bone and the soft tissues. Bone, after all, is nothing but soft tissue plus earthy salts, and one should deal with it as such. One would not deliberately put metal into soft tissue, rather, remove it when accidentally introduced. Why, then, should surgeons put metal into bone? Bone, being living tissue, tries to throw the metal off as a foreign body. One sees this in the plating of fractures. With the plate *in situ* at operation, the fragments are firmly held together, but later, before callus formation has progressed very far, osteoporosis around the screws causes them to loosen, with consequent shifting of the plate. Those plates that remain *in situ* for several years are merely exceptions to the rule. It is most illogical to put metal into bone, and he foresaw that Dr. Albee's bonegraft inlay and peg methods had sounded the knell of all metal fixtures.

Continuing the comparison between bone and soft tissues, take, for example, a nerve that has been divided for some time. There are bulbs of scar-tissue at the ends. The ends are perfectly contacted, but one never gets union. Why? Because the nerve-fibres cannot penetrate the barrier of scar-tissue. When, on the other hand, the bulbous

scarred ends are removed until the brush-like ends of the fibrillæ stand out, and the freshened ends are *accurately* contacted, regeneration occurs, and the nerve resumes its property of conduction. The same state of affairs is met with in an old, ununited fracture. The ends of the fragments are sclerosed (scar-tissue), and with the plate we get contact without union, for the same reason, unless the ends be resected. By the bonegraft inlay method of Albee, on the other hand, healthy bone spans the sclerosed area, and assures union by its osteogenetic, as well as osteoconductive, properties.

DR ALBEE, in closing, said that he had seen silver wire break in several instances in fracture of the patella, in one case coming through the skin. Silver wire in ununited fractures is most untrustworthy. Fixation is a secondary consideration. Something is required to span the sclerosed bone and complete the contact with healthy bone beyond the point of fracture, something that will not only supply bone callus but that will stimulate osteogenesis, and this the bone graft does. He was equally certain that in relatively large grafts a varying part of the central portion acts as a scaffold for migrating bone-cells from the fragments. The reconstruction of the graft is a physiological affair. Regarding extrusion of the graft, there was one case where the graft was applied to the jaw, and the wound connected with the oral cavity, in which practically all the graft came out. In only two in 400 cases has the whole graft been extruded. He had had in several cases little slivers come out. The whole graft has been laid bare by an infected wound and has become covered up with granulations, perhaps little shells have come off, but the graft has served its purpose. It is a most trustworthy surgical agent and of an entirely different class from metal. It has a definite resistance to infection. He had had no experience in the use of the graft in jaw fractures. Some of his cases of fracture of the neck of the femur had been of long duration (*i e*, up to two and one-half years).



# EDITORIAL

## THE CAMPAIGN AGAINST CANCER

THERE is no surgeon to whom the problems of cancer, whether carcinoma or sarcoma, are not of the most engrossing interest. The intensity with which research laboratories, especially maintained and equipped for cancer study, are working to discover the primary cause of the irregular, unchecked proliferation of cells which constitutes cancer, is matched by the eagerness with which surgeons everywhere are endeavoring clinically to check, head off, or eradicate the disease when once started. But every trail which has seemed to promise to lead to a knowledge of the cause of cancer has thus far ended blindly, and in the great majority of instances, the most intelligent and radical clinical effort to overcome this disease when once developed has had but one end—the tragedy of death.

Two points of light, however, appear in this vast cloud of discouragement and disappointment. Research and experience together, as they accumulate, make more and more certain, first, that the condition is primarily a local one, and, second, that up to a certain point in its early history it is susceptible to absolute and definite removal with no danger of return other than the possibility of new development incident to any living tissue.

The full realization of what these two things mean is of vast importance. The belief, widespread in the previous generation, that cancer is from the first a constitutional disease still exerts its baleful influence at the present time, so that many educated physicians are even to-day skeptical as to the possibilities of radical relief from any operative interference. The natural reasoning with such advisors is that when tumors are detected which may possibly be cancerous, it is already too late to interfere with any hope of permanent relief, hence the propriety and desirability of using temporizing measures with the hope that the later history of the case may demonstrate that the first suspicions as to its character were unfounded. The inevitable result of such measures is the postponement of interference until in truth the case has advanced beyond a point where any likelihood of entire eradication of the disease by any local attack has passed.

Unfortunately, this state of mind among practitioners has some

basis in the not infrequently observed fact that indurations, ulcerations, and tumors, which are apparently of a suspicious nature, do sometimes disappear or are recovered from with the lapse of time and the use of simple resolvent remedies. One such case will make a much deeper impression upon the mind of the average observer than the many more cases in which a tumor is found after such watchful waiting to develop unmistakably malignant conditions, and that when once its nature is fully appreciated the opportunity for its radical removal with permanent relief has passed.

Although the natural reluctance of any individual to perform or to undergo an unnecessary operation, especially if it is of a mutilating character, must enter very largely into the problem of the surgical treatment of tumors, on the other hand, even more importance should be given to the much greater and more tragic disaster of postponing radical attack upon a tumor until the possibilities of benefit from such an attack have vanished. There is very much to justify the position of a surgeon who is guided by the principle that it is better to be unnecessarily radical or early in his dealing with many benign growths, than that he should fail to be early enough or radical enough in his dealing with one malignant growth.

Entering into this problem also is the fact that a very considerable proportion of growths, benign in their early history, in their later course develop malignant characteristics. The surgeon who, after the removal of a growth finds that the growth is not malignant, must have a condition of mind far more to be desired than that of the surgeon who, after postponing for a long period any dealing with a growth, finally subjects it to operation, finds that it is of malignant character and that during this period of waiting a diffusion beyond the possibility of entire eradication has taken place.

There is much to justify, therefore, the present day tendency to consider all tumors suspicious and as calling for prompt eradication provided such eradication does not involve immediate danger to life. If such a state of mind could be created throughout the community as a whole, as well as among advanced surgeons, it would clear the field at once of much of the cause for the agitation on the subject of cancer which is occupying the mind of the medical world at the present time.

The importance of early and sufficiently radical removal of suspicious growths constitutes the crux of the whole cancer discussion of the present day. The knife, the cautery, the caustic, the radium and the X-ray are all important, and each one has its place, but each one is secondary to the great principle of early and radical destruction of the

## EDITORIAL

diseased tissue Each agent will leave its best and most lasting results when it is applied at the beginning of the tissue changes which this controls

We have very great sympathy with the crusade which has been organized and is being effectively carried on for disseminating a knowledge of the natural history of cancer and the possibilities of its operative relief which modern surgery presents

The immediate cause which has prompted these remarks is the effort of the Medical Society of the State of Pennsylvania, through its Commission on Cancer, to organize and stimulate a widespread movement among the medical journals of this country to call attention to the facts with regard to cancer as we know them to-day While it is true that the surgeons who form the clientele of the ANNALS OF SURGERY are hardly likely to need any such awakening or stimulation, certainly not any enlightenment, nevertheless, the full sympathy which the ANNALS OF SURGERY has with this movement is such as to cause us to write these paragraphs to express our fullest sympathy with the efforts of our Pennsylvania colleagues

LEWIS S PILCHER

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# ANNALS *of* SURGERY

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## SURGERY AND WAR

ADDRESS OF THE PRESIDENT AT THE OPENING OF THE SESSION OF THE AMERICAN  
SURGICAL ASSOCIATION, JUNE 9, 1915

BY GEORGE E ARMSTRONG, M D  
OF MONTREAL, CANADA

It is difficult, indeed impossible, for me to express my deep appreciation of the high honor of holding the position that I occupy to-day, an honor rightly shared by all the Canadian Fellows of this distinguished Scientific Association. I can only extend to you my best thanks and accompany it with a pledge to devote my best energies to the promotion of the welfare of the American Surgical Association and to do my utmost to increase its influence and power in furthering the Science and Art of Surgery and in raising its efficiency to the highest possible standard for the benefit of the people of this and the other continents. We have already accomplished much, but, if I read the signs of the times correctly, we are on the threshold of greater advances than have yet been. Greater coordination, advances in science generally, our well-equipped laboratories and improved methods of diagnosis must give the surgeon of the future a vision and a power that we older men have scarcely dreamed of.

The Canadian Fellows of this Association have always received a welcome at the meetings of the American Surgical Association that has made us feel quite at home. We one and all look forward to each annual meeting with pleasant anticipations and an assurance that the days spent in attendance will be among the most stimulating scientifically as well as enjoyable days of the year.

Last year our Association entertained the members of the Fourth Congress of the International Society of Surgery. In view of the conditions that now obtain in Great Britain and on the Continent of Europe, the remarks of the President of that Congress, Dr de Page, have renewed interest. After reminding us that the first three meetings of the International Surgical Society had been held in Belgium, he

said, "It is not necessary for me to tell you that it is the privilege of our little Belgium to offer a meeting place to the learned men of all nationalities, covered by Europe herself with the shield of peace and liberty" I confess that I, for one, listened to his paper on War Surgery with a faraway interest

The occurrences of the past few months, however, have brought home to us, as perhaps never before, the subject of the relation of our profession to the science and art of war, and have deprived Dr de Page of his charming and accomplished wife who endeared herself to every member of this Association It is now a living, vital question, and probably every member of this Association has asked himself the question, what part do Surgery and Medicine play in modern warfare? Have the means of saving life kept pace with the amazing development of those agencies used in war to destroy life?

Industrial progress, mechanical inventions, the spread of education and improved organization have greatly changed the military art The perfection and multiplication of roads, the use of steam and gasoline, have rendered the transportation of large masses of troops, ammunition and food more rapid and less expensive in time, money and energy Education and organization combine to render possible the movement of huge bodies of combatants in a coherent, unified mass, acting with a view to intelligent cooperation under the guidance of one supreme intellect War is no longer a blind struggle between mobs and individuals, but a life and death struggle between educated armies led by highly trained, highly educated generals and officers Physical stamina, courage and endurance are not less important than formerly, but intellect and nerve among the officers and in the ranks are the qualities that count most in the warfare of to-day, be it on land, in the air, on the sea, or under the water Furthermore, intellect, education and training are as essential among the non-combatants, statesmen and politicians at home as among the combatants at the front

War surgery of a kind is probably as old as humanity It is safe to say that each period of the past has obtained the best surgery available at the time Little is said of surgery and surgeons in the Old Testament The most careful investigations have failed to make out from their writings whether the Romans regularly appointed physicians and surgeons to their armies or not, although organization has sometimes been treated very fully Sir James Simpson, however, has established very clearly by means of monumental and votive tablets that the Romans appointed a medical officer to each cohort (500 or 600 men), and in addition, a superior medical officer or director to each legion,

which was made up of ten cohorts. In the wars of Justinian, 483-565 A D, the recruits were examined by physicians as to their fitness. There would seem to be little doubt that the Romans made use of field hospitals, crude, no doubt, when measured by modern standards, but evidence of the humanitarian spirit that has in all centuries characterized the work of our profession. Even the American Indians had their Medicine Men.

It is a far cry from the Bowman, and the Single Knight with mail-shirt, sword and lance to the breech-loading rifle, the machine-gun, the siege-gun, torpedo boats, submarines and air-craft, but our profession has made equally great advances and utilized all modern scientific discoveries to their fullest possibilities. If each of the succeeding wars during the ages has possessed greater engines of destruction than the one before, our profession has kept pace by producing greater instruments of relief for the sick and wounded. The science and art of surgery has kept pace with the science and art of war.

It may be said of our profession that we have given of our best. Surgeons have never hesitated to respond to their country's call in time of war, and what a galaxy of names appear down through the centuries as military surgeons. André Vesalius, Paracelsus, Ambroise Paré (1510-1590) whose presence in the army was said to be worth 10,000 men, John Hunter and Larrey, to mention only a few whose scientific work and devotion to duty are recorded on the pages of history, men who were at once a glory to their profession and a credit to their countries. Not only were these men surgeons of resource, but men of untiring energy and unbounded courage. When Larrey had no more meat with which to make broth for his sick and wounded he took the officers' horses and converted them into food. The officers quite naturally made complaints to the Emperor, who asked Larrey if the charge were true, and received the laconic answer, "Yes." Soon afterwards Napoleon made him a Baron. "History must record with admiration the answer of the French Chief of the Medical Staff when the proposal was made to him by Napoleon that the wounded be put out of their misery by opium rather than be left to the mercies of the Turks on the retreat from St. Jean d'Acre through Joffa, he replied, "My vocation is to prolong life and not to extinguish it." After the Battle of Waterloo he was captured and sentenced to be shot. Just fifteen minutes before the time set for his execution he was set free by Blucher, whose son owed his life to Larrey's exertions. At St. Helena Napoleon wrote in his will, "I bequeath to the Surgeon-in-Chief to the French Army 100,000 francs, he is the most virtuous man I have ever known." What courage.

was shown by Surgeon Landon at Majuba Hill when shot through the spine and paraplegic! He caused himself to be propped up and continued his attentions to the injured until he felt himself dying, when he simply said, "Do what you can for the wounded" During the present war Capt Surgeon Rankin continued his attentions to the wounded after one leg had been shot away at the knee-joint Surgeon Read, at the relief of Delhi, when the wounded under his care were threatened by a band of rebels, took his sword and, calling upon ten soldiers to follow him, defeated the enemy and saved the wounded Two of his men were killed and five or six wounded Surgeon Read was a Canadian and the son of a Canadian

One might go on indefinitely with similar illustrations of the quality of the men who have served and are now serving as military surgeons Men who fear nothing when they know they are in the right, men who have shown not less courage and determination in times of distress and danger than the brave and fearless combatant officers

What have Scientific Medicine and Surgery done for the Army and Navy? Have they accomplished as great or greater triumphs in naval warfare and on the field of battle as in civil life in times of peace?

One hundred and fifty years ago 20 per cent, 30 per cent, 40 per cent, and sometimes 50 per cent of the wounded died, to-day 5 per cent or less, although many are now picked up that formerly were left to die

Without delving too far into what Carlyle termed "dry as dust" literature, we may glance at what has been accomplished during the lifetime of some of you here present

In the Crimean War (1854) the wounded were mixed with cases of cholera, dysentery and fever There were no bedsteads, no proper bedding, no nurses, no washing conveniences and often only ships' biscuits for food At best the "witches' cauldron" was brought into the middle of the ward, the patients dipped in their cups, and the bed-ridden were dependent on the generosity of those able to be up Hospital gangrene was prevalent The ever-faithful army surgeon attended the wounded in the open regardless of snow and rain To many he could only give a word of cheer and encouragement, to others a suck from his bottle of rum as he passed among them in the darkness of the night, guided by the groans of the suffering and his small horn lamp Every wound was septic and many of them swarming with maggots The older surgeons were afraid of the newly-discovered chloroform The Director-General almost forbidding its use, adding that the cries of the wounded indicated that there was no fear of syncope and that pain

was a stimulant that aided recovery. The hypodermic syringe was not yet invented. In spite of all these handicaps we are told that the men recovered remarkably well, thanks to the use of tents and abundance of fresh air. Again, the medical officers enjoyed but little independence of action, they were hampered by red tape and not allowed to perform major operations without the consent of the commanding officer.

England was stirred to its depths by the reports of the sufferings of the sick and wounded in the Crimea. On November 4, 1854, Florence Nightingale, with a staff of thirty-seven nurses, partly volunteers and partly professionals, arrived at Scutari in time to receive the Balaclava wounded. She would stand twenty hours at a stretch to see the wounded accommodated. The death-rate, which in February was as high as 42 per cent, before many months had sunk to 2 per cent. She regularly took her place in the operating room to hearten the sufferers by her presence and sympathy, and at night she would make her solitary rounds of the wards, lamp in hand, stopping here and there to speak a kindly word to some patient. Soon she had 10,000 men under her care and the general superintendence of all the hospitals on the Bosphorus. Need we wonder that her character and mission were summed up in a particularly felicitous anagram, "Flit on, cheering angel?"

Great advances have been made since then. The American Civil War marked the introduction of the Ambulance System, although the wounded were, in the main, carried to the rear of the contending parties by the railway hospital. The care of the injured and the sick was much better than in any preceding war in any country. They received the benefit of anæsthesia, and the nursing was much more efficient than any that had been previously obtained. A further advance was made in the Franco-Prussian War, and again in the Boer War.

The Russo-Japanese War may be, I think, regarded as notable in that it would seem that in this war the Army Medical Officers were given a more free hand, greater independence of action and greater authority. The result was surprisingly good. In the South African War, 1899-1902, no fewer than 31,000 men were invalided home on account of typhoid fever, while in the Russo-Japanese War, 1904-1905, the incidence of infective diseases, notably typhoid fever, was reduced to a figure unparalleled in any previous war, only 3.51 per cent of the total sickness being due to enteric diseases, and the entire deaths from infective and contagious diseases amounted to only 1.24 per cent of the entire army in the field.

Among the Japanese soldiers operations for appendicitis, hernia, floating kidneys and gall-stones were conspicuous by their absence, and



this was attributed to their plain, rational diet, one easily digested, metabolized and assimilated. The Japanese soldier was taught how to treat his intestines and his intestines treated him with equal consideration.

Medical and Surgical science is getting a hearing only in recent years. It is no longer a voice crying in the wilderness. Governments, Armies and Navies have learned to appreciate its possibilities. They have been slow to learn that special training is as essential for the Director-General of the Army Medical Service as for the Field-Marshal, the Diplomat and the Statesman, and that here as in other spheres of activity, responsibility must be coupled with power.

Sanitary Science, unknown prior to 1700, has become one of the most efficient agencies for the prevention of sickness among troops and navies.

The Greeks and Romans had no military hospitals and, in fact, they were unknown until the time of the Crusades (twelfth century). They played but a small part in the treatment of the sick and wounded until the end of the sixteenth century, and only in the latter half of the nineteenth century did they arrive at anything like their present degree of efficiency.

Hospital ships are mentioned as long ago as 1673. In 1692 there were two hospital ships attached to each squadron. We have done not less for the navy than the army. The conditions under which Jack lived in the eighteenth century are outlined by Tobias Smollett who served as Surgeon's Mate in the *Cumberland*, which sailed from Spithead on October 26, 1740. Carlyle describes Smollett, Surgeon's Mate, as proud, soft-hearted, though somewhat stern-visaged, caustic, and indignant young gentleman. The descriptions given by Smollett in "Roderick Random" of the way in which the sick and wounded were treated is probably quite correct, although almost incredible to the present generation. In the sick berth he saw about fifty miserable, discontented wretches suspended in rows, so huddled one upon another that not more than fourteen inches of space was allowed for each with his bed and bedding, and deprived of the light of day as well as of fresh air, breathing nothing but a noisome atmosphere of the morbid steams exhaled from their own excrements and diseased bodies, devoured by vermin hatched in the filth that surrounded them and destitute of every convenience necessary to people in that helpless condition. A condition that when compared with the luxurious equipment of a modern hospital ship with its lifts, its operating theatres, its comfortable wards, its baths, its nursing sisters and its large staff of sick berth

attendants, brings clearly before us the value of the contribution of medicine to naval warfare. It is interesting to note in this connection that in addition to properly equipped ambulance trains and motor ambulances, floating hospitals capable of carrying about fifty wounded and their stretchers and attendants are being introduced in France during the present war.

It is wise to look back occasionally to the accomplishments of those who have gone before. One appreciates the value of modern surgery to the world by comparison with the conditions that obtained before the discovery of sanitary science and pathogenic germs.

Do we really do better than did our predecessors?

In the unsuccessful expedition to Porto Bello in 1726, nearly the whole of the crews of the ships were destroyed by fever three times over, 2 Admirals, 10 Captains, 50 Lieutenants and between 3000 and 4000 inferior officers and men perished without striking a blow. In the taking of Havana in 1762, the Earl of Albemarle took with him in the fleet 11,000 soldiers. Between June and the middle of October 560 men perished from wounds and 4708 from sickness. At the end of the Seven Years' War a statement was drawn up in the Annual Register for 1763, from which it appeared that in all the naval battles of that war there were but 1512 sailors and marines killed, while 133,738 had died of disease or were missing. When these figures are compared with those of the Japs in the Russo-Japanese War, which show an army of approximately 600,000 men, the entire deaths from infectious and contagious diseases were only a little over 7500, or 1.24 per cent, we gain some idea of the advance we have made and of the benefits of modern, scientific medicine and surgery.

In the Crimean War 25 per cent of the wounded died, the majority not of their wounds but of complications such as pyæmia, erysipelas, gangrene, typhoid and typhus. In the Russian War (Russo-Turkish), 1877-1878, four times as many died of disease as of wounds. Of the wounded 12 per cent died and of the sick 6 per cent.

In the American Civil War 14.6 per cent of the wounded died and twice as many died from disease as from battle wounds.

In the Boer War less than 9 per cent of the wounded died but twice as many died of disease as of wounds.

In the Russo-Japanese War there died on the Russian side a little over 4 per cent of the wounded and on the Japanese side 6.5 per cent.

Medicine, using the word in its larger sense, has not only reduced the death-rate from wounds, not only lowered the mortality rate by the utilization of the principles of Sanitary Science and Preventive Medi-

cine, not only insured the recovery of the sick and wounded by modern principles and methods of treatment in both medicine and surgery, but it has accomplished another great achievement, an achievement not easily expressed in figures or percentage. It has raised the morale of the army and navy. It has given the men zeal, courage, hope and confidence. This is a great thing and undoubtedly contributes very materially to the increase of valor and fighting efficiency. All praise to Paré, the Frenchman who discovered the ligature, to Morton, the American who discovered anæsthetics, and to Lister, the Englishman who discovered antiseptic surgery.

The future is full of promise. Aeroplane ambulances and aeroplane conveyances will, undoubtedly, very soon take their place in the equipment of every army and every battleship. Sanitary science and preventive medicine will become more and more efficient and the troops may always be assured that the best surgery of the day will be directed to their needs.

We may safely put aside all dreams of a millennium during which there will be no war. "Pacification is an ideal of specious and glittering beauty, yet in the long march of humanity across thousands of years or thousands of centuries, it still remains an ideal, lost in inaccessible distances, as when first it gleamed across the imagination. It has always been there. We find its traces in the *Iliad* and in the *Sagas*, in the verse of Pindar and in the profound and reflective prose of Thucydides. Livy's imagination responded to it, even when with the brush of a Veronese or a Titian he painted the wars of Rome. It informs some of the noblest passages of the *Annals* of Tacitus. It appears as the "Truce of God" in the Middle Ages, and in the orators of the Reformation is pronounced a malediction upon him who wages war unjustly. In the seventeenth century it is proclaimed as the ideal in the name of Religion, in the eighteenth in the name of Humanity, and in the nineteenth in the name of Commerce, Industrialism and the Progress of the working classes" (Prof. Cramb's "Germany and England," 1914).

And yet in the twentieth century Ares, the War God, has many followers ready to contribute brute strength in their wild rage of conflict, and Enyo, the Goddess, is still able to find volunteers for the destruction of cities. The great armies, however, and in greater numbers than ever before, wear Athena's colors and carry on their warfare on approved military lines.

To the disciples of Treitschke and the younger German poets, war is a duty. It wrests Government from the weak and gives it to the strong.

"In truth there is only one way to stop war, and that is for some

great power first to disarm the whole world, and then to see to it that no one shall again take up arms Universal tyranny may create universal peace Nothing else will We know, of course, all that can be said about the tyrant being an International Committee, but such an International Committee must be run by somebody and it would soon become merely a tyrant under an alias A superimposed peace and true freedom cannot keep house together" (*The Spectator*, December 10, 1914 ) And yet the war spirit is as far removed from the life and aims of the Army Medical Service as the poles We minister to all alike There is only one password to a military hospital and it is the same password no matter in what language it is uttered, and it is the simple words, "sick and in need" Our attitude is beautifully expressed by Oliver Wendell Holmes in the following verse

As Life's unending column pours,  
Two marshalled hosts are seen,  
Two armies on the trampled shores  
That Death flows back between

One marches to the drum-beat's roll,  
The wide mouth clarion's bray,  
And bears upon a crimson scroll  
"Our glory is to slay"

One moves in silence by the stream  
With sad yet watchful eyes,  
Calm as the patient planet's gleam  
That walks the clouded skies

Along its front no sabres shine,  
No blood-red pennons wave,  
Its banner bears the single line,  
"Our duty is to save"

# THE INCIDENCE OF HEREDITY AS A FACTOR IN THE CAUSATION OF GOITRE \*

BY JOHN E SUMMERS, M D

OF OMAHA, NEB

IN any discussion of heredity in man, the question of variation is quite as important, the biologists are by no means agreed as to the relation the one bears to the other, but the relation is so intimate that heredity and variation cannot be regarded separately. Members of a family differ from one another and variations in *their* progeny can be explained only by the prepotent domination of either parent under normal metabolic conditions. The greater the prepotency, the less the variation of type, and conversely, in the same family reversion of type marks the recessive. Inheritance presents such a variety of phenomena, that it would be an unlimited task to attempt even to epitomize the theories and proven facts which students of biology have brought forth. For the purpose of this paper we have to consider, first, what is the probable cause of goitre, and then, if possible, apply the most accepted principles of heredity as apparently evidenced in the common occurrence of goitre in several or many members of the same family.

*The Probable Cause of Goitre*—Although goitre is characteristically endemic in certain localities, it is widely spread over most of the world. It is found on all geological formations. It is an accepted fact that drinking water is the intermediary through which the toxin of goitre is conveyed. This was (Blauel) proven by the Sardinian Commission about the year 1848. In a certain village of 1500 inhabitants visited, 900 goitre sufferers were found, 109 were absolute cretins, while in another village, only about one kilometre distant, the people were all strong and well. The water supply of the goitre-free district was not from the same source as that of the goitre district. The water supply of the goitre district was changed, with the result that goitre disappeared. Another example, of which I might give many, is one noted by Blauel, of a report made by the younger Bircher, as follows. In an agricultural neighborhood of Ruppertsweyl, in 1885, 59 per cent of the school children were found to have goitre. In 1884 the people of this community had begun to construct a new water course. In 1889 an inspection of the school children showed 25 per cent goitrous, in 1895, 10 per cent, and

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\* Read before the American Surgical Association, June 9 1915

in 1907, only 2.5 per cent. It is a fact that there are goitre-free regions in the midst of goitre districts, and, on the other hand, isolated goitre spots in goitre-free regions. Emigrants from a goitrous into a non-goitrous district gradually eliminate goitre from their families. Immigrants from a goitre-free into a goitrous district develop goitre in the first generation, cretinism in the second,—demonstrating the increasing *toxicity*. Gaylord, referring to a report by Hancke, 1819, tells of a battalion of 300 healthy men moving into an endemic goitrous district, in which all but 70 contracted goitre, and it was found necessary to remove the regiment to a non-goitrous region, where those not too far advanced recovered,—the enlargement of the thyroid disappearing. Hancke states that in the infected region referred to, individuals who boiled the water and freed it from the precipitate which it contained, and added thereto wine and sugar, very rarely developed goitre.

Now, if goitre is produced by a toxin generated by a microorganism, how may we explain the undoubted evidences of direct heredity or predisposition? Too many thousand examples of family histories have been studied, in which *heredity* seemed the only explanation for the frequent occurrence of goitre, to doubt that such an explanation was the logical one. Many families have a predisposition to goitre, one family has been reported in which 92 members had been afflicted. Many family trees indicate that certain families show a remarkable incidence of the disease, other members show an immunity, as may be the case in tuberculosis. Dr Maude Slye's dissections and studies seem to prove that there is probably a positive hereditary incidence in cancer, I believe *it*, as well as goitre, has a microorganism infection behind it.

Goitre has been produced experimentally in man by the drinking of milk in which was mixed the filtrate of known goitrogenous water. As a control the goitrogenous water was boiled before the filtrate was removed, and given in milk to other subjects of the experiment. No goitres were to be found in the control subjects. The incubation period in man, in experimentally produced goitre, is from 13 to 15 days.

Chemical analyses do not support the view that goitre is due to the presence or absence of certain chemical salts in the water. Neither the proportion of magnesia in the drinking water, of sulphur, or carbonate of lime, nor the content of iodine, or a lack of iodine has been confirmed as a cause of goitre. Since the discovery of radium, theories have been advanced that radio-active substances in the drinking water, particularly radio-thorium, were the exciting cause of goitre. Repin says that goitrogenous water is invariably mineral water, and holds in solution chemical ingredients, possibly salts of lime and magnesia possi-

bly radio-active substances, which are the active principle in producing goitre. In discussing this question, McCarrison, Bircher, Breitner, Lobenhoffer, and others all think that 70° Centigrade causes water to lose its toxic properties, and that it must be some infective agent that causes goitre. The researches of the Swiss Goitre Commission (this Commission is still sitting) have proven that goitrogenous waters almost invariably show an infinitely higher bacterial content than innocuous waters, and we know that in radio-active water the bacterial content is low. McCarrison's experience agrees with that of the Swiss Goitre Commission, he states that the lime and magnesia theory is untenable,—goitre has been found in New South Wales, in villages where the only source of water supply is rain water. It is found in other villages where the water is derived from snow only, and again where distilled water is used for drinking.

Goitre has been produced in rats by feeding them with natural goitrogenous waters, viz. those of Sumiswald and Lauterbrunnen. Pregnant animals drinking goitrogenous waters, although themselves escaping, have brought forth goitrous progeny. Goitre can be produced not only in animals, but in artificially bred trout, and has been found in fish in their natural waters. Taking these statements into consideration, it seems reasonable to concede that goitre is produced by a microorganism. Metabolic and nutritional disturbances may play some part in the irregularities of the function of the thyroid gland. The weight of evidence to date predominating is that the microorganism of goitre is introduced in drinking water as the intermediary. The toxin is most probably produced in the gastro-intestinal tract, and probably the microorganisms multiply in the intestine as a menace to the individual, and as a source of infection to others. Indeed Farrant (*Lancet*, March, 1914) goes so far as to identify the microorganism as an atypical form of *B. coli*. He says the mutants are usually conveyed by water. They become indigenous in the intestine, and different mutants are to be found in the faeces of cases of endemic goitre. The mutants set up an apyrexial toxæmia which stimulates the thyroid, so leading to a colloid hyperplasia, and eventually to enlargement. The whole process can be imitated, and goitre induced in guinea-pigs by feeding with small doses of the mutants. Endemic goitre is preventable by the avoidance of contaminated water. It can be cured by intestinal antiseptics—the gland returns to normal provided no degeneration has taken place.

David Marine regards endemic goitre in brook trout as due to a metabolic disturbance—the result of faulty feeding (diet of liver)—and says that it can be corrected by the feeding of whole sea fish

Gaylord and Marsh classify goitre, in the Salmonidæ, as a carcinoma identical with endemic goitre. Their experiments show goitre in the Salmonidæ to be caused by a living organism in a way practically comparable with experimentally produced goitre in man and animals. Not only can the goitre of the Salmonidæ fish be transmitted to mammals, but it has all the phenomena of spontaneous recovery and immunity.

I have been particularly interested in the question of heredity in goitre because of some personal knowledge of families in which either a more or less direct transmission by infection was responsible for the disease, or else the disease occurred as an acquired inheritance. This acquired inheritance being the result of special chemical changes in the biophores giving rise to the development of the thyroid gland, and its relationship to the thymus, the suprarenal gland, the ovaries, pancreas, etc. In the modern sense an infectious disease cannot be inherited, and it is stated by pathologists that, "the microbe of an infectious disease cannot be a constituent of the biophore." Congenital goitre and cretinism are probably, like syphilis, of intra-uterine origin. Familial goitre, more particularly when the members of the family live in widely-separated neighborhoods in goitre-free districts, can, as must so-called hereditary syphilis, be explained as derived from "the infective state" of the parents, and is strictly an inheritance. Familial inheritance of resistance to disease, immunity, as well as the continuance of certain physical characteristics for generation after generation, is well known. This can be best explained by the Mendelian precept of dominants and recessives. It strikes me that there is a well-marked resemblance between the development of congenital goitre and congenital syphilis. Examples of mothers (women and animals, free from goitre) producing congenitally goitrous progeny, would seem to bring forth the same rule as applied in Colles's law, although the law has, in a measure, been modified by serological research. Later serological research may be able to extract a toxin showing, as in the Wassermann reaction, a latent stage of the thyroid disease.

I have been induced to consider heredity in goitre from a clinical stand-point because I have had to operate in families in which there seemed no explanation for the goitre other than heredity. Recently I have operated a mother and her three daughters for goitre, and there are more members of the family who have goitre—there being, likewise, an ancestral history of goitre. I have had somewhat similar experiences in other families. I have noted particularly a family in the practice of Dr. J. H. Cole, of Council Bluffs, Iowa, where there was no familial history except that the father and mother had goitre, three



children dying in infancy, all had goitre, another infant eight days old; with a goitre threatening asphyxiation, was successfully operated by Dr Donald Macrae, the four older living children each had a goitre. My experience teaches me that Plummer's clinical classification of goitre, based upon pathological studies, is a very important one. This classification has, I believe, a wider significance, in that it is applicable where goitre is an inheritance, or at least has an apparent hereditary cause in its formation. Particularly may this apply in the prophylactic removal of non-hyperplastic goitres before there is a development of inherited toxic properties. The disease, from a hereditary stand-point, as passed down from parent to offspring, may not be *the same* in each, because elements determining the possibility and types of growth, in one offspring may be dominant, and in another recessive, and strongly influenced by differences in metabolism.

# LAPAROTOMY IN TYPHOID FEVER<sup>1</sup>

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DURING the last few years there has been a marked decrease in the number of cases of typhoid fever, due to our better knowledge of this disease, and hence better sanitation and more careful selection of food and drinking water. Besides this we have now an antityphoid vaccine which has rendered the disease a most uncommon one in the army, where its use is compulsory and which may in time make typhoid fever as 'uncommon as small-pox.

Year by year the cases of typhoid in our large hospitals are becoming fewer and fewer, but as long as any occur we are always liable to see cases in which certain accidents or complications occur, which render surgical intervention a necessity.

Much has been written of late about operation for typhoid perforation. If this serious complication is unrecognized and not operated upon, it is always fatal, and it is only by prompt recognition by the medical attendant and prompt action by the surgeon that the life of the patient can be saved. In this matter, as in so many other acute abdominal emergencies, the rule of operating before a positive diagnosis is made is a most excellent one, and a strong suspicion of perforation demands immediate action. A small pin-point perforation with very slow escape of the intestinal contents gives a different clinical picture from that of a large opening caused by the sloughing of the Peyer's patch and the overwhelming dose of the liquid poison.

Of course not all patients can be saved by early laparotomy, and many patients will die of the typhoid infection regardless of operation. An exploratory opening of the abdomen does not necessarily mean great shock or added risk. It is perfectly easy in almost any of these cases to operate with a local novocaine anæsthesia or even spinal anæsthesia. As a rule the lesion is easily recognized with comparatively little handling of the intestine, because we know pretty well where to look for such perforation.

The general practitioner has been better trained to recognize an acute appendicitis and hence surgeons can report long series of operations without a death, partly due of course to the better technic,

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<sup>1</sup> Read before the American Surgical Association June 9, 1915

but more to the fact that the surgeon is called to the case before the patient is moribund

Some years ago the most successful operator in the world would have had a very considerable percentage of mortality even could he have used the modern methods. Only by refusing to operate upon desperate cases could his statistics have shown such favorable results as at present.

I will not enter into the discussion of the symptoms, signs of perforation, and the generally accepted indications for operation, they have been thoroughly studied and written up in the last few years. Hemorrhage, which not infrequently causes a fatal termination of the disease, has been occasionally considered a reason for opening the abdomen. I can think of no more desperate undertaking than trying to find the location of such a hemorrhage and check it by surgical means. In indirect transfusion I think we have a much more safe, rational and fully as efficient a means of saving life.

Suppuration of the gall-bladder is one of the complications that must always be borne in mind. Many years ago I had a young man brought into the hospital with no history, and as he was delirious no history could be obtained from him. The abdomen was distended and in the right upper quadrant was a large sensitive mass, the temperature was high and the man was in a desperate condition. Under primary anæsthesia the abdomen was opened, a large and almost gangrenous gall-bladder was discovered and drained, he died the next day. At autopsy it was found that he had typhoid, and that the suppurating gall-bladder was due to the typhoid infection. My medical colleagues seemed to think that it was a mistake on my part to have operated, but I assured them that though the man might possibly have recovered from his typhoid, *per se*, he certainly was killed by his gangrenous cholecystitis. Here again it is possible in most cases to open the gall-bladder and drain it as soon as the condition is recognized, without the use of a general anæsthetic.

I do not claim that all infected gall-bladders should be opened in typhoid, but we know that a very large percentage of them do become infected by the typhoid bacilli and years later we find the result in gall-stones for which we operate, but I do maintain that the gall-bladder might be explored more frequently to the advantage of the patient. Many of these remain infected for a long time after the patient has apparently recovered from the original disease. We occasionally find gall-bladders filled with pus and mucus which give pure cultures of the typhoid bacillus. Is it not possible that such patients might be the so-called carriers of the disease? It is well known that the urine

may contain typhoid bacilli long after the patient is up and about, and although the cystic duct may be so blocked that it seems impossible for any of the gall-bladder contents to pass, it is probable that a certain amount does get by and might well be a source of infection for months and even years, the organism breeding there like pin-worms in an appendix

All carriers of the disease, like the famous "typhoid Mary," should be thoroughly examined and if bacilli are found, not in the urinary but in the intestinal tract, surgical exploration and excision of the gall-bladder should be done. It is certainly reasonable to believe that an infected gall-bladder, sidetracked as it is from the intestinal stream, could go on producing typhoid bacilli, which can be eliminated slowly, giving rise to no danger to the patient, but could be of considerable menace to all about him

Operations during an acute stage of typhoid if properly carried out cannot add materially to the danger, and I am sure in many cases they may do good, although no perforation or other gross lesion is discovered. One of the first cases on which I operated expecting to find perforation, towards which the symptoms seemed to point, showed no intestinal opening and the abdomen was washed out with salt solution and closed, the temperature immediately began to fall and the patient recovered promptly. This result of a laparotomy has been noticed by many operators, who have seen it in the perforating and non-perforating cases as well. Is it not possible that in typhoid we may have a peritoneal sepsis without perforation, and that laparotomy and perhaps washing out with salt solution may have a beneficial effect?

There are many cases of peritoneal infection caused by the germs of septic sore throat, the pneumococcus, or the tubercle bacillus, that are cured by an early laparotomy. In a recent epidemic of septic sore throat caused by milk, I saw 5 patients with abdominal infection, 3 of these were late cases and pus was present in large quantities, they all died, the other 2 were early, showing reddened peritoneum and slight excess of free fluid, and both recovered.

During my hospital experience I tried for years to be allowed to operate on suitable cases, but until perforation was almost assuredly present the medical man would not listen to the idea. I may be entirely mistaken, but from the cases that I have seen and the experiences of other men, as they have been told to me, I can but feel that there is a group of unrecognized opportunities for surgical relief. I have few facts to support my belief, and I only make the suggestion in the hope that the profession will bear the possibilities in mind.

# ACUTE APPENDICITIS OCCURRING IN THE COURSE OF TYPHOID FEVER

BY HOMER GAGE, M D.  
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PAIN, tenderness and muscular spasm located in the right iliac region, and occurring in the course of a typhoid fever, are common enough to make the differential diagnosis between typhoid and appendicitis often very difficult, and always important

A study of the reported cases shows how easily a simple typhoid may be mistaken for an acute or subacute appendicitis

Among the unoperated cases in which appendicitis may be said to have been only suspected, are those of Moizard, Moty, Chapenay, Giozeffi, and Fazio, beyond the presence of the above-mentioned symptoms, there would seem to be no good reason for assuming that any of them were more than simple uncomplicated typhoid

Among the cases that were subjected to operation, those of Maurange, Muhsam, Rendu, Moty, and some of Kelly's presented no real evidence of acute inflammation of the appendix, and had the condition disclosed by operation been known beforehand, the operation would in no case have been undertaken

I have had one similar experience myself, having operated on a young man with symptoms of acute inflammation in the right iliac region, which I thought were due to an acute appendicitis. Operation disclosed a normal appendix, and the patient went through a typical run of typhoid fever. In spite of the handicap of an unnecessary operation he recovered, but the possibility of such an error, and its possibly fatal consequences, must be ever borne in mind

The difficulties in diagnosis have, however, been made very much greater by the discovery that the appendix does share, to a greater or less extent, in the intestinal lesions of typhoid. One of the earliest suggestions of this sort is contained in the case of Sands, reported before the New York Pathological Society in 1857. The patient died of general peritonitis caused by a perforation of the appendix, and the solitary and agminated glands of the small intestine had "the appearance which they often present in typhoid fever"

Buhl had, three years before, reported the results of autopsies in 3 cases of supposed typhoid fever, in which general peritonitis and a perforated appendix were found. A more convincing case was that of Murchison, reported in 1865, in which, in addition to extensive lesions

in the ileum and cæcum, four typical typhoid ulcerations were present in the appendix

Moore presented 4 similar cases to the Pathological Society of London in 1883. A further contribution was made by Fitz, who in 1891 reported 167 collected cases of perforating typhoid ulcer, in 5 of which the appendix was the seat of the perforation.

Rolleston in 1898 published the results of 60 post-mortem examinations made at St George's Hospital upon patients dying of typhoid fever, from which it appears that the appendix was swollen in 5, ulcerated in 7, and perforated in 2. He adds one case of perforation of the appendix close to the cæcum, with general intestinal ulcerations found at autopsy.

In the following year Hopfenhausen reported a study of the appendix in 30 autopsies performed during an epidemic of typhoid in St Petersburg, and although in but 2 cases were typical typhoid ulcerations found, he found that in most of the cases the appendix shared in the pathological alterations produced by the disease in the intestinal canal—the lesion in most cases being limited to a marked cellular infiltration of its walls.

Christian found the appendix showing decided changes in 19 of 119 autopsies upon typhoid fever patients. Rostowzew, quoted by Hesse, found an abnormal condition of the mucous membrane of the appendix in 60 per cent of the autopsies in typhoid fever, but found only one case of superficial ulceration, and in several hundred autopsies, but 4 cases of perforation.

These references to a few of the more important articles in the literature of the subject are enough to show that the appendix frequently shares in the typhoid process, and that pathological changes, amounting even to perforation, are a far from uncommon complication.

Clinically these cases are usually grouped into three classes—the first class includes those cases in which appendicitis is purely accidental, occurring concurrently with typhoid in the same individual, or in which a chronic appendicitis may be roused into activity by typhoid fever.

In the second class, the appendicitis may arise from a typhoid affection of the lymph follicles, or from an ulcer situated in the appendix. In the third, appendicitis may follow typhoid fever appearing within such a brief time after the subsidence of the fever as strongly to suggest a causal relation—a causal relationship which is, however, fairly open to more than a reasonable doubt.

The cases which occur within the first few days, or before convalescence is really assured, would seem to me to fall within the first

or second group, and the third should be left to include only those in which an interval of health has intervened between the recovery from the typhoid and the incidence of the appendicitis

In this class would seem to belong the case referred by Stokes and Amick in the *Johns Hopkins Bulletin* for 1905, which is notable as the only reported case in which a culture of Eberth's bacillus has been found. A medical student, who had had typhoid 13 years before, was seized with a typical attack of appendicitis

At operation the appendix was found three times its normal size, gangrenous, and about to rupture at its centre. The bacillus of typhoid was found in cultures taken from two places, and was contaminated with the bacillus pyocyaneus. His Widal was positive, but instead of pointing to a recent infection, as the authors seem inclined to believe, wouldn't it represent exactly what might be expected to occur in the case of a typhoid carrier?

In any event it illustrates what seems to me a typical instance of the so-called post-typhoid appendicitis. In this same group should be included cases in which sharp angulation or stricture has resulted from the cicatrization of a typhoid ulcer, as is set forth by Hesse, though I have found no recorded example of this form

Of the other classes, the first represents those cases in which the appendicitis seems to be a purely accidental complication, and is best illustrated by the first and third cases reported in the very interesting paper by Perron, in the *Revue de Chirurgie* of 1905

These were cases of acute appendicitis occurring near the end of an attack of typhoid. In neither case was there anything in the gross or microscopic appearance of the specimens to suggest a true typhoid lesion, and in both, the bacteriological examination revealed a mixed infection, without any trace of the bacillus typhosus. There is apparently no connection between the typhoid infection and the concomitant appendicitis

The second class includes the cases of true appendicitis typhosa, in which typical typhoid ulcers are found in the appendix during the course of the fever or at autopsy

We have already referred to the observations of Moore, Rolleston, Hesse and others, which have established the existence of typhoid lesions in the appendix at autopsy. Five illustrative cases in which the evidence was obtained at operation are quoted by Kelly—3 were from personal communications of Dr J B Murphy, 1 from Dr McMonagle, and 1 from the Johns Hopkins Hospital records—and still another case has been reported by Dr J N Hall

All of this evidence makes it very clear that typhoid changes may and do occur in the appendix, similar in appearance to those which are found in the lower part of the ileum and in the cæcum, and, further, that they give rise to an acute inflammation of the appendix that may or may not terminate in perforation

In none of the reported cases, as far as I have been able to discover, has the presence of the typhoid bacillus been noted, except in that already referred to in the report of Stokes and Amick, and that was in a case that had had typhoid 13 years before

In Walther's case reported in 1913, the patient's blood was negative with Eberth's bacillus and with the paratyphoid A, but strongly positive with paratyphoid B, cultures from the appendiceal abscess disclosed the presence of the same organisms

Failure to report the presence of the true typhoid bacillus may have been simply an oversight, and is perhaps of no vital importance, but it seems to me that it makes the history of the following case of especial interest

R W, nineteen years old, an active athletic young man, whose family and personal histories are both good, was taken with severe headache about December 1, 1910, ten days after a possible exposure to typhoid infection. He had a high temperature when first seen, and in five days had a positive Widal reaction, he entered the Worcester City Hospital on December 7, where a second positive Widal was obtained

Typical rose spots over chest and abdomen were present on December 11, and the spleen was readily palpable. Defervescence was gradual, and the temperature reached normal on the fifteenth, and remained so until the twentieth. At 1 30 of the morning of December 20 he awoke with severe abdominal pain, more intense in the lower right quadrant, and accompanied by a spasmodic contraction of the right rectus. He vomited once. His leucocyte count, which had been 7100 on the twelfth, and 8200 on the fourteenth, had risen at 6 30 in the morning to 14,500, at 7 30 it was 15,000, at 9 00, 18,000, at 11 30, 17,300. At 1 00 P M his temperature was 100° and his pulse 100

A diagnosis of probable perforation was made, and the abdomen immediately opened. A mass was felt in the region of the appendix, in the midst of which was an ounce of thin pus, and an acutely inflamed appendix, gangrenous at one spot, and covered with a thick exudate, but unruptured. This was removed, and the convalescence was uneventful. The especial point of interest was the report of the pathologist, Dr F H Baker, which I quote in full



Specimen consists of appendix and cultures from appendix abscess. Gross examination shows appendix to be about 8 cm in length, uniformly thickened throughout, averaging 1-2 cm in diameter. It is acutely inflamed, with its distal third covered with a thick, dirty, grayish exudate. The blood-vessels of the serous coat are markedly distended.

There is an ulceration about 5 mm in diameter in the mucosa about 3 cm from the tip, which extends down to the serous covering. The lumen contains a small amount of pus and liquid feces. Microscopical examination of sections at different levels shows an acute infection everywhere, *i e*, there is a marked polynuclear infiltration of all coats of the appendix.

Sections through the point of ulceration show a characteristic lesion of typhoid, *i e*, in the lymphoid tissue of the mucosa are areas infiltrated with endothelial leucocytes. Cultures from the appendix abscess show growths of streptococci and motile bacilli. These bacilli are transplanted on various media and identified positively as *Bacillus typhosus* and *Bacillus coli*.

Stained sections of the appendix showed an intense infection with non-Gram staining bacilli in mucosa, and a similar infection of streptococci throughout all structures of the appendix.

Anatomical diagnosis. Typhoid ulceration of the appendix.

In this case we have an instance of an acute gangrenous appendicitis, occurring at the beginning of convalescence from an attack of typhoid fever. Its presence in the exudate and in the walls of the appendix would seem to indicate that the *Bacillus* of typhoid was taking at least an active part in the process, and when we take into consideration the presence of a typical typhoid ulcer, and the cases already referred to in which similar ulcerations have been found in the appendix in the course of the fever, I think we are entirely justified in regarding them all as definite and logical sequences of the intestinal infection.

I am further inclined to believe that careful pathological and bacteriological examinations would show that some, at least, of the so-called simple or accidental cases of appendicitis occurring in typhoid fever are wrongly classified, and that true typhoid appendicitis is really more common than present figures would indicate.

When the inflammation of the appendix occurs after the temperature has become normal, and the possibility of an intestinal perforation has become very small, the diagnosis is not much more difficult than in cases of simple uncomplicated appendicitis, although in my own case I operated in the expectation of finding a perforation.

The symptoms are not very unlike, and the indications for operative interference are identical. The prognosis, however, appears to be much more favorable when the lesion is in the appendix than when it is in the intestine proper, largely perhaps because there is so much less danger of fecal extravasation.

## APPENDICITIS IN TYPHOID FEVER

The importance of a rising white count must never be overlooked. As pointed out by Cushing in 1900, "the appearance of leucocytosis in the course of typhoid fever points toward some inflammatory complication in its early stages"

In my own case, twice within eight days the count had been 7000 and 8000, and within a few hours after the onset of the pain it rose to 14,000, then to 15,000, and, in eight hours, to 18,000. A similar rise is of course present in intestinal perforation, and in every case is usually an indication for prompt surgical interference.

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# ACUTE CHOLECYSTITIS COMPLICATING TYPHOID FEVER \*

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THERE are numerous surgical complications of typhoid fever of which acute cholecystitis is one of the more uncommon. The following case is an example of this complication.

J. J. C. entered a medical service of the Boston City Hospital, September 29, 1906, suffering from typhoid fever.

*Previous History*—Negative.

*Present Illness*—He had been complaining of general malaise, frontal headache, pain in joints, and weakness for a few days.

*Physical Examination*—Showed a man, twenty-eight years of age, medium height and well nourished. General physical examination negative. On the abdomen were a few rose spots, spleen palpable. No abdominal spasm or tenderness.

October 7. Had shown no complications and was considered a moderately sick patient suffering from typhoid fever. This afternoon he had an intestinal hemorrhage and passed about four ounces of blood. He was given morphia and an ice bag was applied to the abdomen. Diet by mouth omitted for some hours. There was no recurrence of hemorrhage during this illness.

October 23. Up to this time nothing unusual had occurred. On this date the temperature rose to 104° from 101° on the previous day, and the pulse rose to 120. There was some general spasm of the abdominal muscles in the right half of the abdomen. Palpation revealed no mass except that the spleen could be felt. No further complication was in evidence and it is doubtful if a cholecystitis were suspected.

October 27. Patient had an attack of severe pain referred to a point just below the right costal margin, accompanied by more or less general spasm. This acute pain subsided and he complained of a dull ache over the whole abdomen.

The above notes are extracted from the medical record. I saw him in consultation about ten hours after the attack of sudden abdominal pain.

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## CHOLECYSTITIS IN TYPHOID FEVER

*Examination*—Patient emaciated and pale, general condition very poor, tongue dry and coated, peritoneal facies, abdomen generally markedly rigid, no distention, tenderness most marked in the right lower quadrant. A diagnosis of probable intestinal perforation with spreading peritonitis was made, perforation of gall-bladder was not suspected nor examined for.

*Operation*—Ether. A right rectus incision was made, extending down from the level of the umbilicus. On opening the peritoneal cavity considerable bile-stained fluid escaped. Exploration showed much fibrinous exudate and light adhesions around the cæcum and the coils of small intestine in that vicinity. The usual signs of typhoid ulcers of the lower ileum were in evidence but no intestinal perforation was found. In the region of the gall-bladder were many fibrinous adhesions and it was obvious that we had to do with a perforated gall-bladder. Hence, the original incision was closed quickly and the usual one made over the gall-bladder. This organ was exposed by breaking down the adhesions, and bile-stained pus was observed escaping from a small perforation on its inferior aspect, near the cystic duct. Except at this spot, there appeared to be no gangrene of its wall. A probe was passed and no gall-stones were detected. This opening was closed with catgut sutures and covered with the stomach and colon which happened to converge at this point and were fastened there with a catgut suture to wall off the site of perforation. The fundus of this considerably enlarged gall-bladder was then opened and drained in the usual way with a tube fastened in. An additional wick of gauze was passed beneath the gall-bladder.

This patient convalesced gradually without further complication. There was some discharge of bile until December 1, and the sinus finally closed about January 1. The pus obtained from the gall-bladder was reported to be "sterile."

*Historical*—In 1880 Eberth demonstrated that a certain bacillus was the cause of typhoid fever and subsequently it was discovered that it is capable of producing suppuration. As early as 1829 Louis observed a condition of acute suppuration in the gall-bladder during an attack of typhoid fever. At autopsy Futterer discovered typhoid bacilli in the gall-bladder in 1888, and two years later Gilbert and Girode found these bacilli in both the bile and the wall of the gall-bladder after cholecystectomy. In Keene's exhaustive monograph on Surgical Complications of Typhoid Fever, written in 1898, only 4 cases are recorded of operation for suppurative cholecystitis due to the typhoid bacillus.

*Condition of Normal Bile*—In health it is supposed that the bile

of man and animals is sterile, and experimentation shows this to be true in animals. Bile recovered from a supposedly normal gall-bladder in man during operation for other conditions is generally found to be sterile. For example, in one series of 23 cases the bile was sterile in 18. Bile possesses very little, if any, antiseptic quality against pyogenic bacteria, on the other hand, it is found to be a fairly good culture medium for typhoid and colon bacilli. In the presence of suppurative lesions in the gastro-intestinal tract, bile frequently contains bacteria. After ligation of the common bile duct in animals, bile becomes infected. Bacteria may be present without causing any lesion of the gall-bladder, appearing in pure culture or mixed infection.

*Mode of Entrance of Typhoid Bacilli, Occurrence of Typhoid Cholecystitis*—Typhoid bacilli may enter the bile by one of three routes: 1. In most instances they enter by the circulatory system passing through mucous membranes into the bile. 2. They may be excreted directly by the liver cells into the bile. 3. It is possible but improbable that they ascend the biliary ducts directly from the duodenum.

As a rule, their presence alone is not enough to cause inflammation and it is the best opinion that they are present in the bile in all cases of typhoid fever. While they are supposed to be absent from all other organs in a few weeks after the subsidence of the fever, their stay in the bile may be indefinite. Their persistence in the gall-bladder is probably due to a certain degree of chronic cholecystitis which may not give rise to clinical symptoms and signs. Occasionally such instances occur without a previously recognized attack of typhoid fever. Such patients are known as typhoid "carriers" and, of course, are dangerous to the community. Typhoid bacilli frequently remain in the gall-bladder many months and sometimes years after an attack, often in pure culture. One instance of twenty-six years is recorded.

Although bacilli are generally present in the bile during an attack of typhoid fever, they do not frequently cause an acute cholecystitis. In a large series of autopsies, where death was due to typhoid fever, 2 per cent were complicated by cholecystitis, in a series of 2864 clinical cases, 18 are recorded as having had cholecystitis, and in another such series of 895 cases,  $1\frac{1}{3}$  per cent were so affected. In a series of 2000 autopsies after typhoid fever at Munich, only five cases of cholecystitis were found. Hence, this is an uncommon complication.

The time of the onset is more often during the third week of the fever and occurs with decreasing frequency as the case progresses. It may come on during convalescence or during a relapse, and has been known to occur independent of any recognized attack of typhoid fever.

It may be that typhoid bacilli, unaided by other factors, are capable

of causing an acute cholecystitis, but such cases are probably exceptional. This is demonstrated by the fact that, although bacilli are believed to be present in bile in about all cases, this complication of typhoid fever is unusual. Bile stasis from any cause favors the growth of bacteria which are often found in pure culture without the presence of gall-stones. Such attacks are probably provoked by œdema, due to a certain amount of inflammation of the ducts, giving rise to biliary stasis. In other instances of acute cholecystitis complicating typhoid fever, gall-stones have been found. In one series of about 200 cases of acute typhoid cholecystitis, gall-stones were present in 20 per cent. Hence, we are led to conclude that attacks are provoked by obstruction to the escape of bile or by injury from foreign bodies in the gall-bladder.

*Pathology*—The pathology does not differ from that produced by other pyogenic bacteria. We have to deal with an acute catarrhal inflammation involving, primarily, the mucous membrane of the gall-bladder and it may extend to such degree as to destroy eventually the wall of the gall-bladder. We may have a superficial inflammation of the mucosa or a more or less extensive necrosis resulting in perforation. There may be multiple ulcers of the mucosa. In most cases perforation occurs near the cystic duct, but it may take place at any point.

*Symptoms*—The symptoms and signs of acute cholecystitis due to the typhoid bacillus are the same as those caused by other pyogenic bacteria, but the clinical picture may be very different. If the attack occurs during the height of the fever, it may be entirely masked by the toxic condition and stupor of the patient, and even go on to perforation of the gall-bladder before being suspected. Many mild cases occurring at this time are probably overlooked. If the attack comes on during the period of convalescence or later, the usual symptoms should be observed.

Pain in the vicinity of the gall-bladder is the first complaint, but it may be referred to the epigastrium or, less frequently, toward the right lower quadrant of the abdomen. It is more or less constant and there may be exacerbations of sharp or colicky pain. At about the same time the gall-bladder region is tender and, according to the amount of tenderness, there is a varying degree of muscle spasm over it. The above symptoms become worse as the inflammation progresses. Very often one can palpate a distended gall-bladder and it may be large enough to produce dulness. There may be nausea and vomiting. These are the early symptoms and such a condition would not be often overlooked if a careful daily routine examination were made. This should

be done in all cases and localized tenderness over the gall-bladder should make one suspicious of such a complication

Meanwhile, certain constitutional changes may be evident. There may be chills or a sudden rise in temperature, if it had previously reached normal, or an additional elevation, if already above normal. The pulse is increased. There may be a leucocytosis of from ten to fifteen thousand and this is significant, because the leucocyte count is not increased in uncomplicated typhoid fever. Jaundice is absent unless there is common bile duct obstruction. The above is the picture of an attack of acute catarrhal cholecystitis. The symptoms may gradually subside spontaneously and complete resolution follow and, undoubtedly, many such cases occur. On the other hand, the cystic duct obstruction may persist and the nutrition of the gall-bladder wall be so interfered with as to produce necrosis which, in turn, is followed by perforation and escape of vesicular contents with or without the formation of adhesions. As a rule, a fatal peritonitis follows unoperated cases.

The signs attending the perforation may be overlooked but should not be if the case is observed with care and regularity. The perforation is generally characterized by sudden pain, often with collapse, soon to be followed by the typical signs of an acute spreading peritonitis, which need not be considered here. The symptoms attending perforation of the gall-bladder do not differ very materially from those caused by perforation of the intestine, which is both commoner and more difficult to cure and, therefore, more serious. If, however, the possibility of a cholecystitis with perforation is borne in mind, fewer errors in diagnosis will be made. On opening the abdomen the presence of bile-stained fluid will be conclusive evidence of the type of lesion.

*Diagnosis*—It would seem as though an attack of acute cholecystitis ought to be detected in the majority of instances provided the patient were watched carefully for this complication. Local tenderness and spasm are the chief signs and should be somewhat in evidence notwithstanding the presence of marked toxæmia and stupor due to typhoid fever. Such complication should not escape detection after this period.

An enumeration of a list of lesions for differential diagnosis would include the following: Intestinal perforation, right-sided pulmonary lesions, gastritis, perforation of gastric or duodenal ulcer, appendicitis, acute pancreatitis, peritonitis from any cause.

*Prognosis*—Because this complication is commoner during the course of the fever, it is probable that the prognosis, other things being equal, is more grave than when due to other pyogenic bacteria. Many cases of acute cholecystitis, of varying degrees of severity, resolve spon-

## CHOLECYSTITIS IN TYPHOID FEVER

taneously but no one can predict the outcome in any given case. In a series of 154 cases, 25 per cent perforated. The prognosis depends chiefly upon whether perforation takes place. With rare exceptions perforation is followed by a fatal peritonitis when the case is left unoperated. The outcome of operative interference depends upon many factors. The condition of the patient already may be grave because of the severity of the attack of fever. The lapse of time between perforation and surgical intervention is a factor of the greatest importance, as after any visceral perforation. Prognosis is better if the attack takes place in the late stage of fever and better still at a later period. Mixed infection adds to the gravity, as does also extensive cholangitis. The mortality in the various series of operated cases of perforation as reported runs from 22 to 54 per cent.

*Treatment*—The treatment of cholecystitis due to the typhoid bacillus does not differ materially from that due to other pyogenic bacteria, although the operative mortality is greater for obvious reasons. Primarily it is of the greatest importance to have this complication in mind so that, when discovered, its progress may be watched and appropriate treatment instituted. Remembering that tenderness and spasm over the region of the gall-bladder are the early and important signs, it is a very simple matter to make a daily routine examination of this area.

Operation should be avoided if possible because of the general condition of the patient and because many of the cases are mild and resolve spontaneously. If the symptoms increase in severity, it is probably the best judgment to operate. If the gall-bladder can be palpated, this means that there is distention due to obstruction of the cystic duct. If not operated upon, such a gall-bladder will probably empty itself only by perforation, and this additional complication should be avoided if possible. Hence, progress of the local signs without evidence of remission and the presence of a palpable gall-bladder are indications for interference. If perforation of the gall-bladder has taken place life will depend, other things being equal, upon the promptness of operation.



# PATHOLOGY OF SPLEENS REMOVED FOR CERTAIN ABNORMAL CONDITIONS OF THE BLOOD \*

## PRELIMINARY REPORT

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THIS study is a continuation of a previous report<sup>1</sup> which covered the pathologic examination of 26 spleens removed at operation or autopsy in the Mayo Clinic, between November 14, 1905, and November 1, 1912, from patients on 18 of whom a more or less positive clinical diagnosis of splenic anæmia had been made, and of two "wandering spleens" removed at operation within the same period

The present preliminary report covers the examination of 31 more spleens removed at operation, between December 3, 1912, and June 9, 1915. Further study of the several groups will be reported later. The cases have been studied clinically by Giffin,<sup>2</sup> whose grouping is observed in the following brief abstracts of the pathologic protocols

### GROUP I CLINICAL DIAGNOSIS—SPLENIC ANÆMIA

CASE I—A76471 F B, male, aged thirty, duration of symptoms 6 months, splenectomy December 3, 1912. Weight of spleen 1520 grammes, notch distinct, marked perisplenitis over convex surface, capsule thickened, on section, tough, hard, with marked fibrosis. Microscopic examination shows diffuse hypertrophic fibrosis (chronic splenitis), pulp 1 †, lymphoid tissue 1, reticulum 4, endothelium of sinuses 1, pigment 3, amyloid degeneration 3, arteriosclerosis 3.

CASE II—A77560 M P, female, aged twenty-four, duration of symptoms 12 months, splenectomy December 28, 1912. Weight of spleen 1770 grammes, notch obliterated, exterior nodular, on gross section, hard, firm, tough. Microscopically, there is diffuse hypertrophic fibrosis (chronic splenitis), pulp 1, lymphoid tissue 1, reticulum 4, endothelium of sinuses 2, pigment 1, amyloid degeneration 3, arteriosclerosis 3.

CASE III—A82918 O N T, male, aged thirty-three, duration of symptoms 36 months, splenectomy April 25, 1913. Weight of spleen 2000 grammes, four notches, one over tip, exterior slightly roughened, no perisplenitis, on gross section, fairly hard and tough, vessels thick-walled. Microscopic sections show diffuse hypertrophic fibrosis (chronic splenitis), pulp 1, lymphoid tissue 2, reticulum 4, endothelium of sinuses 2, pigment 1, amyloid degeneration 1, arteriosclerosis 3.

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\* Read before the American Surgical Association, Rochester, Minn., June 10, 1915.

† The figures 0, 1, 2, 3, 4 indicate relative amounts.

## PATHOLOGY OF SPLEENS REMOVED

CASE IV—A48060 W A C, male, aged thirty-four, duration of symptoms 12 months, splenectomy April 2, 1913 Weight of spleen 600 grammes, notch distinct, but not marked, surface smooth, slight perisplenitis at hilum, somewhat firm on section Microscopically, there is diffuse fibrosis (chronic splenitis), pulp 2, lymphoid tissue 2, reticulum 3, endothelium of sinuses 3, pigment 1, amyloid degeneration 3, arteriosclerosis 1

CASE V—A89075 N B S, male, aged thirty-five, duration of symptoms 6 (?) months, splenectomy October 10, 1913 Weight of spleen 1030 grammes, broad, flat, with well marked notch, surface slightly nodular, considerable perisplenitis, capsule thickened, on section, fairly hard and tough, amyloid changes showing grossly (sago spleen) Microscopically, there is diffuse hypertrophic fibrosis (chronic splenitis), pulp 2, œdematous, lymphoid tissue 2, œdematous, reticulum 3, endothelium of sinuses 3, œdematous, pigment none, amyloid degeneration 3, arteriosclerosis 2

CASE VI—A99539 A F D, male, aged forty-five, duration of symptoms 48 months, splenectomy February 3, 1914 Weight of spleen 680 grammes, thin, flat, marked double notch, considerable perisplenitis, capsule thickened, cuts rather easily, gross subcapsular amyloid changes Microscopic sections show diffuse fibrosis (chronic splenitis), pulp 1, lymphoid tissue 1, reticulum 3, endothelium of sinuses 3, pigment none, amyloid degeneration 2, arteriosclerosis 1

CASE VII—A109051 S F R, female, aged forty-five, duration of symptoms 60 months, splenectomy July 9, 1914 Weight of spleen 560 grammes, very slight notch, gland normal in shape, exterior slightly nodular, very little perisplenitis, capsule not thickened, cuts readily, slightly harder than normal Microscopic sections show diffuse fibrosis (chronic splenitis), pulp 1, lymphoid tissue 2, reticulum 3, endothelium of sinuses 3, pigment none, amyloid changes 1, arteriosclerosis 1

CASE VIII—A118388 C H B, male, aged twenty-four, duration of symptoms 36 months, splenectomy November 24, 1914 Weight of spleen 900 grammes, normal symmetry, very slight notch, surface nodular, slight perisplenitis, capsule not thickened, on gross section, hard, firm, tough, marked amyloid (sago spleen), vessel walls grossly thickened Microscopically, there is diffuse hypertrophic fibrosis (chronic splenitis), pulp 2, lymphoid tissue 2, reticulum 3, endothelium of sinuses 2, pigment 0, amyloid degeneration 4, arteriosclerosis 2

CASE IX—A118619 S T, male, aged sixteen, duration of symptoms 60 months, splenectomy November 26, 1914 Weight of spleen 875 grammes, elongated, marked notch on each margin, marked perisplenitis, capsule thickened, considerable subcapsular pigmentation in some areas, firm and hard on section Microscopically, there is a diffuse hypertrophic fibrosis (chronic splenitis), pulp 2, lymphoid tissue 2, reticulum 4, endothelium of sinuses 2, pigment 2, amyloid degeneration 1, arteriosclerosis 2

CASE X—A119565 A M, female, aged sixty-one, duration of symptoms 12 (?) months, splenectomy December 9, 1914 Weight of spleen 500 grammes, elongated, deep single notch, slight perisplenitis, exterior slightly nodular, cuts readily, only slight increase in density Microscopic sections show diffuse fibrosis (chronic splenitis), pulp 1, lymphoid tissue 2, reticulum 2, endothelium of sinuses 3, pigment 0, amyloid degeneration 1, arteriosclerosis 0

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CASE XI—A115696 H F, female, aged forty-four, duration of symptoms 120 months, splenectomy October 21, 1914 Weight of spleen 830 grammes, elongated, multiple notches on both edges, surface roughly nodular, on gross section, cuts with some increased resistance, one large infarct, considerable amyloid degeneration Microscopically, there is diffuse hypertrophic fibrosis (chronic splenitis), pulp 1, lymphoid tissue 2, reticulum 3, endothelium of sinuses 2, pigment 0, amyloid degeneration 2, arteriosclerosis 3

CASE XII—A121871 H E, male, aged fifty-four, duration of symptoms 8 months, splenectomy January 13, 1915 Weight of spleen 950 grammes, surface smooth, slight perisplenitis, capsule not thickened, on gross section, fairly firm, slight fibrosis Microscopic examination shows a diffuse hypertrophic fibrosis of moderate degree (early chronic splenitis), pulp 2, lymphoid tissue 2, reticulum 2, endothelium of sinuses 2, pigment 0, amyloid degeneration 0, arteriosclerosis 2

CASE XIII—A77736 C B, male, aged twenty-six, duration of symptoms 12 months, splenectomy January 13, 1913 Weight of spleen 2290 grammes, gland broad, one small notch, surface nodular, marked perisplenitis, capsule markedly thickened, considerable amyloid (sago spleen), hemorrhages in several areas with pigmentation Microscopic examination shows marked diffuse hypertrophic fibrosis (chronic splenitis), pulp 2, lymphoid tissue 1, reticulum 4, endothelium of sinuses 1, pigment 2, amyloid degeneration 3, arteriosclerosis 3

CASE XIV—A64405 M R C, female, aged twenty-eight, duration of symptoms 36 months, splenectomy April 9, 1913 Weight of spleen 1346 grammes, thick, with small notch, external surface slightly roughened, considerable perisplenitis, capsule slightly thickened, one large infarct, amyloid degeneration (sago spleen) Microscopic examination shows diffuse hypertrophic fibrosis (chronic splenitis), pulp 2, lymphoid tissue 2, reticulum 3, endothelium of sinuses 1, pigment 1, amyloid degeneration 2, arteriosclerosis 0

CASE XV—A132194 T K, female, aged fifty-one, duration of symptoms 24 months, splenectomy June 9, 1915 Weight of spleen 1200 grammes, normal symmetry with marked notches both borders, surface markedly nodular, very little perisplenitis, gross section shows subcapsular amyloid degeneration Microscopically, there is diffuse hypertrophic fibrosis (chronic splenitis), pulp 2, lymphoid tissue 2, endothelium of sinuses 2, pigment 0, amyloid degeneration 2, arteriosclerosis 1

### SUMMARY OF PROTOCOLS OF GROUP I—SPLENIC ANÆMIA

It will be seen from the above protocols that the average age of the patients with a blood picture of splenic anæmia at the time of operation was thirty-six years The average duration of symptoms was 32 months The average weight of the spleen was 1130 grammes This is a little higher than the average weight (1040 grammes) of the spleens from our positive splenic anæmia (revised clinical classification) cases reported in 1913 The average of the two groups is 1093 grammes Few of the specimens equal the weights given by Lyon,<sup>3</sup> who states that the average weight is 62 ounces (1860 grammes) This discrepancy is probably due to the fact that Lyon's figures are drawn

largely from autopsy reports, while ours are from operative material, the spleen continuing to enlarge until death. In general the change in the shape of the spleen is not so marked as the change in size. In other words, the hypertrophy is evenly diffuse except in those cases in which infarcts have occurred. The maintenance of the notch is important from the stand-point of clinical diagnosis.

Histologically, the most constant features are the marked reduction of the pulp and lymphoid tissue with the great increase of reticulum and the almost constant presence of amyloid degeneration and arteriosclerosis. Whether the diffuse hypertrophic fibrosis is the result of inflammatory changes, has not been accurately determined. I see no reason at present, however, to change from the commonly accepted theory that the process is one of low grade chronic inflammation. In this connection it may be noted that Bunting has isolated a diphtheroid organism in pure culture in four out of twelve tubes shown from the spleen in our Case XII.

#### GROUP 2 CLINICAL DIAGNOSIS—ACQUIRED PERNICIOUS ANÆMIA

CASE I—A98774 M S, female, aged fifty-four, duration of symptoms 3 months, splenectomy December 11, 1914. Weight of spleen 360 grammes, normal in contour with well-marked notch, external surface slightly nodular, no perisplenitis, on gross section, cuts freely, firm but not tough. Microscopically, there is a well-marked lymphocytosis with a slight fibrosis, pulp 3, lymphoid tissue 3, reticulum 2, endothelium of sinuses 2, atrophic, pigment 1, amyloid 0, arteriosclerosis 0.

CASE II—A112160 D Mc, female, aged fifty-five, duration of symptoms 24 months, splenectomy August 11, 1914. Weight of spleen 300 grammes, general contour fairly normal, small notch on each border with deep groove connecting the two, surface slightly nodular, no perisplenitis, on section, capsule not thickened, cuts readily, though firm. Microscopic examination shows a marked lymphocytosis with a slight fibrosis, pulp 2, lymphoid tissue 4, reticulum 2, endothelium of sinuses 2, atrophic, pigment 0, amyloid degeneration 0, arteriosclerosis 0.

CASE III—A112836 D D B, female, aged forty-eight, duration of symptoms 36 (?) months, splenectomy August 27, 1913. Weight of spleen 910 grammes, short, broad, thick, notch almost obliterated, surface slightly roughened, on gross section, the gland is firm, hard, tough and very dark colored. Microscopically, there is a diffuse hypertrophic fibrosis (chronic splenitis), pulp 2, lymphoid tissue 2, reticulum 3, endothelium of sinuses 2, atrophic, pigment 0, amyloid degeneration 1, arteriosclerosis 1.

CASE IV—A124257 M S, male, aged twenty-six, duration of symptoms 12 months, splenectomy March 10, 1915. Weight of spleen 500 grammes, fairly normal contour, with well-marked notch, external surface smooth, no perisplenitis, on section, organ is hard though not tough. Microscopically, there is a marked lymphocytosis and moderate fibrosis, pulp 2, lymphoid tissue 4,

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reticulum 2, endothelium of sinuses 2, atrophic, pigment absent, amyloid degeneration 1, arteriosclerosis 0

CASE V—A127677 C H, male, aged thirty-five, duration of symptoms 3 (?) months, splenectomy April 17, 1915 Weight of spleen 186 grammes, fairly normal in contour, very slight notch, on gross section, fairly firm but not tough Microscopically, there is a marked lymphocytosis with atrophic fibrosis, pulp 1, lymphoid tissue 4, reticulum 1, endothelium of sinuses 2, atrophic, pigment 0, amyloid degeneration 0, arteriosclerosis 0

CASE VI—A129678 D D B, female, aged forty-eight, duration of symptoms 108 months, splenectomy June 4, 1915 Weight of spleen 486 grammes, general contour thickened, external surface slightly nodular, slight perisplenitis, on gross section, capsule not thickened, organ cuts readily, though firmly, no fibrosis Microscopically, there is a marked lymphocytosis with a slight fibrosis, pulp 2, lymphoid tissue 4, reticulum 2, endothelium of sinuses 2, atrophic, pigment 0, amyloid degeneration 0, arteriosclerosis 0

CASE VII—A128367 J H D, female, aged forty-one, duration of symptoms 3 months, splenectomy June 5, 1915 Weight of spleen 500 grammes, in contour, broad and thick with very slight notch, external surface smooth, no perisplenitis, on section, organ is firm, but not tough Microscopically, there is a marked lymphocytosis with a moderate fibrosis, pulp 2, lymphoid tissue 3, reticulum 2, endothelium of sinuses 2, pigment absent, amyloid degeneration absent, arteriosclerosis absent

### SUMMARY OF PROTOCOLS OF GROUP 2—ACQUIRED PERNICIOUS ANÆMIA

The average age of patients with pernicious anæmia was forty-four years at the time of operation The average duration of symptoms was 27 months The average weight of the spleens removed was 463 grammes Only one was less than normal (195 grammes) <sup>4</sup> The increase in weight is out of harmony with our conception of the atrophy usually found in the spleen in cases of pernicious anæmia <sup>5</sup> Here again the discrepancy is probably accounted for by the fact that in the last stages of pernicious anæmia the spleen becomes atrophic, while our figures, based on operative cases, show an increased weight of the organ

Cytologically the increase is mostly in the lymphoid tissue, though it is worthy of note that in one case (Case III) there was a well marked fibrosis, this spleen weighing almost twice the average weight of the glands in the series The almost entire absence of pigment in these relatively early stage cases is again in contradiction to the usually accepted statement that in cases of pernicious anæmia the spleen is pigmented

### GROUP 3 CLINICAL DIAGNOSIS—HÆMOLYTIC ANÆMIA

CASE I—A122468 J B McG, male, aged sixty-four, duration of symptoms 15 months, splenectomy January 23, 1915 Weight of spleen 1120 grammes, organ very thick with well-marked notch, external surface roughened, marked

## PATHOLOGY OF SPLEENS REMOVED

perisplenitis, on section, capsule is not thickened, organ is hard and firm, but not tough, very pale, little amyloid Microscopically, there is a diffuse hypertrophic fibrosis with lymphocytosis (chronic splenitis), pulp 2, lymphoid tissue 3, reticulum 3, endothelium of sinuses 2, swollen, no pigment, amyloid degeneration 2, considerable hemorrhage

### GROUP 4 CLINICAL DIAGNOSIS—SECONDARY INFECTIOUS OR SEPTIC SPLENOMEGALY

CASE I—A107092 J P H, male, aged thirty-one, duration of symptoms 3 months, splenectomy June 27, 1914 Weight of spleen 700 grammes, organ swollen, no notch, marked perisplenitis, on section, gland is fairly firm, though soft and not tough, several small infarcts Microscopically, there is a subacute splenitis, pulp 2, necrotic, lymphoid tissue 3, swollen, reticulum 2, endothelium of sinuses 2, atrophic, pigment absent, amyloid degeneration absent, no arteriosclerosis

### GROUP 5 CLINICAL DIAGNOSIS—SYPHILIS WITH SPLENOMEGALY

CASE I.—A119102 G H I, female, aged forty, duration of symptoms 24 months, splenectomy December 4, 1914 Weight of spleen 900 grammes, gland normal in contour, with very marked notch and dorsal groove, external surface slightly nodular, considerable perisplenitis, on section, organ is firm, tough and very dark colored Microscopically, there is a diffuse fibrosis with a moderate lymphocytosis, pulp 3, lymphoid tissue 3, reticulum 3, endothelium of sinuses 2, atrophic, pigment 1, amyloid degeneration 0, arteriosclerosis 3

CASE II—A125899 H S D, female, aged thirty-two, duration of symptoms 10 (?) months, splenectomy April 1, 1915 Weight of spleen 670 grammes, gland long and slender, no notch, slightly roughened surface, considerable perisplenitis, on gross section, organ is pale and firm, but not tough Microscopically, there is a moderate diffuse fibrosis, pulp 2, lymphoid tissue 2, reticulum 3, endothelium of sinuses 2, swollen, pigment 0, amyloid degeneration 0, arteriosclerosis 2

### GROUP 6 CLINICAL DIAGNOSIS—HÆMOLYTIC JAUNDICE

CASE I—A41779 J T G, female, aged fifty-one, duration of symptoms 42 months, splenectomy October 28, 1913 Weight of spleen 640 grammes, gland broad, thick, with well-marked notch on each border, surface rough, considerable perisplenitis, on section, organ is pale, firm and hard Microscopically, there is a moderate hypertrophic fibrosis, pulp 1, lymphoid tissue 2, reticulum 3, endothelium of sinuses 2, pigment 1, amyloid degeneration 0, arteriosclerosis 1

CASE II—A86218 A J H, female, aged thirty-three, duration of symptoms 18 months, splenectomy June 30, 1913 Weight of spleen 900 grammes, elongated, very slight notch, external surface nodular, considerable perisplenitis, on gross section, organ firm, hard, but not tough Microscopically, there is a hypertrophic fibrosis (chronic splenitis), pulp 2, swollen, lymphoid tissue 3, swollen, reticulum 3, endothelium of sinuses 2, pigment 0, amyloid degeneration 0, arteriosclerosis 1

### GROUP 7 CLINICAL DIAGNOSIS—LYMPHOSARCOMA

CASE I—A108557 C V, male, aged forty-five, duration of symptoms 2 months, splenectomy July 3, 1914 Weight of spleen 1870 grammes, very broad and thick, very deep notch on border, surface rough and scarred by infarcts,

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on section organ is soft and dark Microscopically, there is a diffuse lymphosarcoma, pulp 4, lymphoid tissue 4, reticulum 1, endothelium of sinuses 1, atrophic, pigment 0, amyloid degeneration 0

### GROUP 8 CLINICAL DIAGNOSIS—ACUTE FEBRILE NON-SEPTIC (?) SPLENOMEGALY

CASE I—A117048 L J L, male, aged thirty, duration of symptoms 1 (?) month, splenectomy October 27, 1914 Weight of spleen 1940 grammes, gland swollen, slight notch, external surface smooth, some perisplenitis, on gross section, organ is soft and dark colored Microscopically, there is a parenchymatous hyperplasia, pulp 3, lymphoid tissue 3, reticulum 1, endothelium of sinuses 3, swollen, pigment 0, amyloid degeneration 0, arteriosclerosis 0

### GROUP 9 CLINICAL DIAGNOSIS—SPLENOMEGALY WITH EOSINOPHILIA

CASE I—A81201 F H, male, aged thirty-one, duration of symptoms 12 months, splenectomy July 15, 1914 Weight of spleen 2110 grammes, organ very thick, broad, well-marked notch, external surface rough, very marked perisplenitis, on section, gland is very soft Microscopically, there is a marked parenchymatous hyperplasia, pulp 4, lymphoid tissue 2, reticulum 1, endothelium of sinuses 2, swollen, pigment 3, amyloid degeneration 0, many eosinophiles throughout splenic tissue

### GENERAL SUMMARY OF THE LAST SEVEN GROUPS

The cases of hæmolytic anæmia, lues, and hæmolytic jaundice resemble pathologically the cases of splenic anæmia The cases of secondary infection, lymphosarcoma, acute febrile non-septic splenomegaly, and splenomegaly with eosinophilia have little pathologic relationship to either splenic anæmia or pernicious anæmia The lymphosarcoma case is a typical lymphoma whose malignancy was shown clinically The other three cases give the general picture of an intense acute or sub-acute infection, causing hypertrophy and hyperplasia of all the parenchymal elements of the spleen without material increase in the reticulum

Our knowledge of the pathology of splenomegaly associated with chronic changes in the blood has made slow progress, largely because—except in rare instances—we have been unable to study spleens from such cases until the later or terminal stage of the diseases has been reached Now that splenectomies are becoming more common, it is fair to assume that clinicians will be on the lookout for large spleens in all cases of pathologic conditions of the blood and that we may hope for opportunity to study early pathologic changes in the glands removed at operation If any progress is to be made, however, we must sharply differentiate the relative changes in the various histologic elements of the spleen and these changes must be studied in correlation with accurately observed clinical phenomena At present the clinical diagnoses of splenic anæmia, pernicious anæmia, secondary infectious anæmia,

hæmolytic jaundice, Gaucher's disease, etc , are all lacking in clearness, a condition which must be materially improved upon before an instructive parallel may be shown—if, indeed, any exist—between the several clinical syndromes in their various stages and the pathologic picture present in the spleen

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## CLINICAL NOTES ON SPLENECTOMY \*

BY H. Z. GIFFIN, M D  
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IN June 1913 I<sup>1</sup> published a detailed report of the clinical observations in 27 cases of splenectomy. At the present time, it is my purpose to review not in detail but only in a general way the clinical characteristics of the 58 cases of splenectomy in our Clinic since 1904. One of our patients is alive and well eight years after operation. In this instance the history was analogous to that of splenic anæmia, while the spleen showed pathologically a lymphocytic hyperplasia, not, however, with any definite evidence of malignancy. The next longest period for which a patient has remained well is seven years. In this instance there was a clinical history similar to that of splenic anæmia, while pathologically the spleen showed endothelial proliferation and the case might be said to correspond to the Gaucher type of splenic anæmia. One patient has been alive and well for six years, 2 patients have been in good health five years, 2 four years and 3 three years following operation. Pathologically the spleens in these latter cases showed a connective tissue increase with an atrophy of the Malpighian bodies.

Many types of splenomegaly are necessarily represented in this series and any classification of the cases is, of course, open to discussion and criticism. On the basis of their clinical and pathologic characteristics, they will be presented in groups as follows:

### SPLENECTOMY, APRIL 6, 1904-JUNE 9, 1915

1 Splenic anæmia (pathologically diffuse fibrosis)	27 cases
2 Gaucher's disease (endothelioid hyperplasia)	3 cases <sup>2</sup>
3 Pernicious anæmia	7 cases
4 Hæmolytic anæmia (marked splenomegaly)	2 cases
5 Secondary infectious or septic splenomegaly	5 cases
6 Lues (marked splenomegaly)	2 cases
7 Acquired hæmolytic hæmatogenous jaundice	2 cases
8 Cirrhosis of liver	1 case
9 Myelocytic leukæmia	1 case
10 Lymphoma or lymphosarcoma	3 cases

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\* Read before the American Surgical Association, June 10, 1915

<sup>1</sup> A complete study of the cases will appear in a series of papers upon the different types of splenomegaly.

<sup>2</sup> Two of these cases have been questioned. A more detailed report will be published later.

## SPLENECTOMY

11	Tuberculosis of spleen	1 case
12	Wandering spleen	2 cases
13	Acute febrile non-septic? splenomegaly	1 case
14	Splenomegaly with marked eosinophilia	1 case
Total		58 cases

*Splenic Anæmia*—In this group have been placed the 27 patients in whom the enlargement of the spleen was very great and in whom splenomegaly seemed to be the primary condition. The development of a severe type of anæmia with low color index and the absence of leukocytosis were regarded as essential. Hæmatemesis occurred in a majority of the cases. Pathologically all the spleens showed an increase of connective tissue. There were 3 operative deaths in the group, while the total number of deaths was 8 in ten years. Hemorrhage was the cause of death in 2 instances, in 1 case occurring one year after operation and in the other five and one-half years. In 3 other instances hemorrhage occurred 2 and 3 times at different periods after operation, but the patients are at present in good health. It is, therefore, evident that the patients in this group had a low operative risk and an excellent prospect of cure.

*Gaucher's Disease*—Our 3 cases in which the spleen showed evidence of endothelioid hyperplasia occurred early in the series. We have been unable to obtain a history of familial tendency in any of them. One of these patients is in excellent health seven years following operation. In 2 patients the spleen had probably been enlarged since adolescence.

*Pernicious Anæmia*—Seven patients with pernicious anæmia have been operated on in our clinic since August, 1914, with 1 operative death. A second patient died two months after operation with severe anæmia. The third patient, two and one-half months after operation, is in very good health with hæmoglobin at 70 per cent. In the fourth patient the condition of the blood rapidly improved after the operation and the hæmoglobin was 75 per cent in three months. The fifth patient, nine months after operation, has gained 23 pounds, the hæmoglobin is 70 per cent and the red blood count 3,026,000. The last 2 patients are at present in the hospital. It is therefore seen that in our small series of splenectomies for pernicious anæmia there was 1 operative death, 1 death at two months, while 3 of the patients showed marked temporary improvement. Many patients with pernicious anæmia have presented themselves for diagnosis but we have hesitated to advise surgical treatment.

*Hæmolytic Anæmia with Very Much Enlarged Spleen*—There were 2 cases of an unusual type in which the anæmia was severe in character but in which the typical count of true pernicious anæmia was not present and in which the spleen was very much larger than that ordinarily seen in pernicious anæmia. The first patient (A7040) was operated on February 10, 1910. The blood count showed a rather high color index, not, however, above 1, and there were a few normoblasts and megaloblasts in the smears. The spleen was very large, weighing 1640 grammes. After operation showers of normoblasts occurred, a finding which is quite unusual in other types of splenomegaly save that of pernicious anæmia. The second patient was operated on January 23, 1915. The spleen was enlarged early in the history of the disease, apparently before the development of anæmia, the blood findings were similar to those of the first patient and the spleen was large, weighing 1120 grammes.

It is true that these 2 cases may in reality be pernicious anæmia, but the great size of the spleen, the fact that at no time was the blood typical of pernicious anæmia, and the further observation that the enlargement of the spleen occurred early in the disease, would rather lead to the conclusion that they belong to a separate group in the production of which a disturbance of splenic function may have been primary and in which the reaction of the bone marrow was different from that in splenic anæmia.

*Secondary Infectious or Septic Splenomegaly*—Under this heading have been placed 5 cases in which the enlargement of the spleen was not marked, in which the splenomegaly did not seem to be a primary factor in the production of anæmia and in which there was evidence of preceding abdominal or systemic sepsis. One of these patients is in good health five years following operation.

*Lues with Splenomegaly*—There were two instances in which large non-gummatous spleens together with secondary types of anæmia were present in patients with strong positive Wassermann reactions. In one of these the liver was smooth and specific treatment had been given elsewhere without benefit. Splenectomy was followed by marked improvement. In the other instance large palpable gummata were present in the liver. These were very much reduced by specific treatment before operation, but the size of the spleen and the degree of anæmia were not affected. In this case improvement has also been marked since splenectomy.

*Acquired Hæmolytic Hæmatohepatogenous Jaundice*—Two cases have been classified as hæmolytic jaundice. It is possible that both of

them might also be regarded as advanced forms of cholangitis with cirrhosis of the liver. The chronic jaundice, however, was prominent in these patients and the anæmia was marked.

*Cirrhosis of the Liver*—One case has been regarded as cirrhosis of the liver. In this patient neither was the spleen large, nor the anæmia marked. Advanced cirrhosis of the liver was found at operation.

*Myelocytic Leukæmia*—A patient classified in our report of 1913 as a case of splenic anæmia and so regarded by careful observers in other clinics, but of whom it was noted at the time that the blood picture was not entirely satisfactory for this grouping, continued to be in fairly good health for five and one-half years, after which the leucocyte count became increased to 64,000 with 14 per cent of myelocytes.

*Lymphoma or Lymphosarcoma*—Our series includes 2 cases of lymphosarcoma of the spleen. One of the patients remained well for several years but finally died with generalized sarcomatosis nine years after operation. The second patient was operated on July 3, 1914, at which time there was no evidence of metastases. After operation, however, general glandular enlargement rapidly occurred and death supervened five months later. A third patient presenting a decided lymphocytic hyperplasia pathologically but no definite evidence of malignancy is well eight years after operation. This case may be benign.

*Tuberculosis of the Spleen*—In 1904, a large spleen which proved to be tuberculous was removed from a patient who at the time of operation gave no definite evidence of tuberculosis elsewhere in the body.

*Wandering Spleen*—Two cases of this type were operated on because of pain resulting from twisted pedicle. These patients are both alive and well three and seven years following operation.

*Acute Febrile Non-septic Splenomegaly*—Several of the cases in this series were very unusual in their clinical manifestations and in the combination of conditions present. One of them was analogous in many ways to those cases occurring in Egypt and reported as Egyptian splenomegaly and deserves detailed description.

The patient was a man, aged thirty years, who gave a history in which there was no record of previous disease. He had seemed to be toxic and somewhat stupid for 6 or 8 weeks, while a remittent fever reaching  $103^{\circ}$  had been present. There had been abdominal enlargement for only 2 weeks, but no history of hæmatemesis, while ascites was present at the time of examination and the spleen could be felt on ballottement. Wassermann test, Widal reaction, blood cultures, etc., were negative. In spite of the history of

fever and the acute course of the disease, there was no leucocytosis but a definite leucopænia with a relative increase of lymphocytes and an anæmia of the secondary type with hæmoglobin at 70 per cent. The patient remained under observation for 3 months, the condition became less acute in character, and splenectomy was finally decided on. The spleen was very large, weighing 1940 grammes, and the liver was somewhat cirrhotic. (The patient remained weak after operation, had 3 hemorrhages from the bowels, and finally died 5 months following operation.) The acute course, the presence of high fever, the rapid development of a very large spleen and ascites, the absence of leucocytosis and other evidence of sepsis and the absence of jaundice formulate the picture of a most unusual type of splenomegaly.

*Splenomegaly with Marked Eosinophilia*—As far as we have been able to determine there is no case of this type to be found in the literature.

This patient was a man, aged thirty-one years. He was first seen in our Clinic in March, 1913. He had had a continued fever which was diagnosed as typhoid eight years previous, and had complained of weakness since that time. Transitory œdema had been present for ten months and had become extreme within ten days. At the time of his first visit there was a general anasarca, on account of which he was placed on milk diet, and the œdema disappeared in ten days. The blood count at that time showed a secondary type of anæmia with hæmoglobin at 69 per cent and a leucocyte count of 15,400, while the most remarkable feature was the presence of a 66 per cent eosinophilia. The patient was under observation for three months, during which time many blood counts were made and verified by experienced hæmatologists and the eosinophiles varied from 58 to 77 per cent. Wassermann tests were negative, stools were negative, and the examination of muscle for trichinæ was also negative, although not entirely satisfactory. The great enlargement of the spleen persisted and operation was finally decided on and performed in July, 1914. The spleen weighed 2110 grammes. The patient has done well since the operation, his leucocyte count, however, has risen to 138,000, of which from 75 to 80 per cent are eosinophiles. There is very little basis for speculation as to the possible etiology of this unique case.

#### RESUMÉ

Our series of 58 cases includes 27 of splenic anæmia, 3 of the Gaucher type of splenic anæmia, 7 of pernicious anæmia, 2 of hæmolytic

## SPLENECTOMY

jaundice, 5 of secondary infectious or septic splenomegaly, 2 of an unclassified type of hæmolytic anæmia with marked splenomegaly, 2 of lues, 3 of sarcoma or lymphoma, 2 wandering spleens and 1 each of myelocytic leukæmia, cirrhosis of the liver and tuberculosis of the spleen. In addition, it includes 1 case of acute febrile non-septic splenomegaly which is analogous in its clinical course to Egyptian splenomegaly, and 1 case in which splenomegaly was associated with an extremely high eosinophilic count. Splenic anæmia is, in our experience, most favorable for surgical treatment. The operative risk is relatively low and the prospect for a return to normal health excellent. Three of the 7 patients with pernicious anæmia have shown temporary improvement up to 9 months after splenectomy. Removal of the spleen in non-gummatous splenomegaly associated with syphilis has been attended with excellent results in two instances.

## SURGICAL CONSIDERATIONS OF SPLENECTOMY \*

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*Splenectomy*—The safety of splenectomy depends on careful separation of the attachments of the spleen and its delivery without injury to the vascular pedicle. Therefore much depends on the size and movability of the spleen and the amount and vascularity of its adhesions as well as on the thickness of the abdominal wall.

*Incision*—Bevan<sup>1</sup> in 1897 described a most satisfactory incision for operations on the gall-bladder and biliary passages which has been modified by various surgeons. A longitudinal incision is made through the upper rectus muscle extending obliquely along the costal margin, about an inch and a half from it and up toward the ensiform cartilage. The longitudinal part of the incision may be carried down to any desired length permitting careful abdominal exploration. In this respect its value in operations on the biliary tract is very marked, as an appendix may be removed or any necessary operation may be performed on the pyloric end of the stomach or duodenum. The incision made on the left side is equally advantageous in gaining access to the spleen. In working in the biliary region the longitudinal part of the incision is best made in the inner half of the rectus muscle, for splenectomy it is best made in the outer half. If the incision across the rectus muscle is kept an inch or more from the costal margin, this little flap, when caught with a catspaw, makes an excellent retractor.

*Adhesions*—In most cases in which splenectomy is necessary, the spleen is enlarged and adherent to the parietal peritoneum and diaphragm especially over the upper pole. These adhesions differ greatly in their vascularity, being occasionally purely vascular, composed of a small artery and one or more varicose veins. Since these vessels cannot be seen and controlled until the spleen is loosened from its bed and drawn down, it is usually best to separate them with the fingers as close to the spleen as possible, trusting the control of any hemorrhage to a large gauze pack until the spleen can be delivered and removed (Fig. 1).

At times the spleen is firmly fixed in position by adhesions so strong they must be divided by a cutting instrument. By making an opening in the adhesions close to the splenic capsule and loosening the spleen as

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\* Read before the American Surgical Association, June 11, 1915

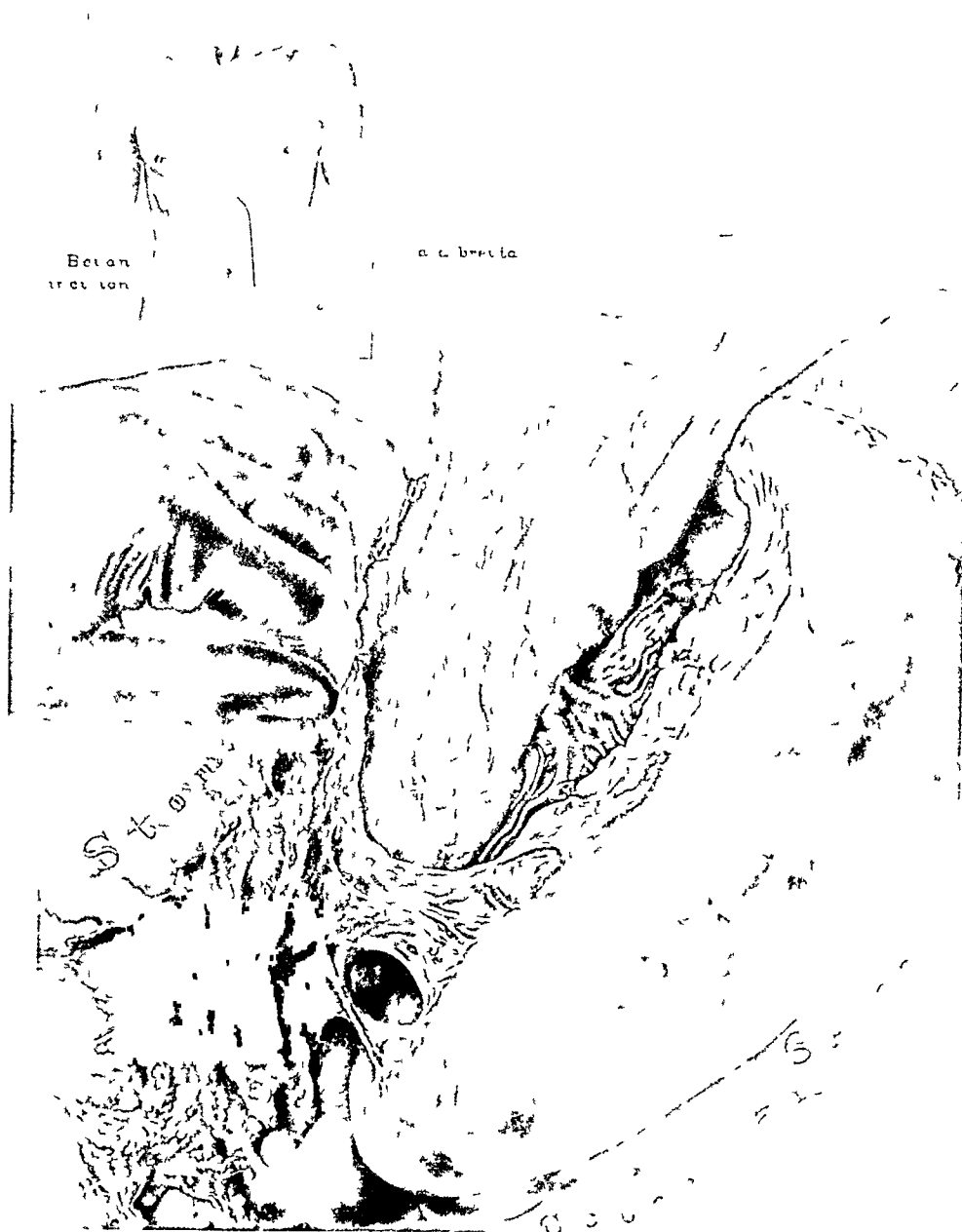


FIG 1 —The Bevan incision for splenectomy shown in upper figure. Lower figure—method of using gauze pack for temporary hæmostasis to control bleeding of separated adhesions





FIG 2 —Closure of splenic space by snaking catgut suture to control oozing of blood from deep seated areas

far as possible by a combination of enucleation and division, a very adherent spleen may safely be removed

A subscapular splenectomy, in the sense one speaks of a subscapular nephrectomy, is not possible. The capsule of the spleen is closely associated with the splenic pulp which is lacerated in the attempt to remove it from within the capsule, causing great loss of blood. With a little care, however, the spleen can be separated immediately at the capsule, leaving the attachments in a condition so there will be comparatively little bleeding. In this way the spleen can be quickly delivered and the pedicle temporarily controlled by fingers or an elastic rubber-covered pedicle clamp. The main thing to be accomplished is to leave the separated attachments in such condition that a gauze tampon will temporarily prevent bleeding. In two cases in my earlier experience the spleen was so firmly fixed with vascular adhesions, I did not deem it wise to undertake splenectomy.

*Separation of the Splenic Ligaments*—Much may be learned concerning the normal relations of the spleen by operative work on the cadaver. The most serious vascular attachments are the vasa brevia in the gastrosplenic ligament which pass to the stomach. However, the bulk of these attachments can be delivered with the spleen, since the stomach can be drawn from the abdomen to a very considerable extent before separating the gastrosplenic ligament. Unfortunately, in a large adherent spleen there may be vascular connections in the deeper portion of the gastrosplenic ligament which pass inward and backward to anastomose with vessels along the spine and the crux of the diaphragm. Since these must be separated before the spleen can be eviscerated, early careful adjustment of an adequate gauze tampon, for temporary control of hemorrhage, may be essential. The lienorenal ligament has no great vascularity and can be readily divided. After the delivery of the spleen, the remainder of the gastrosplenic ligament and a leash of vessels passing to the inferior border of the spleen which connect it with the splenic flexure of the colon are tied in sections. This completes the peritoneal and omental attachments about the hilum, and, by dividing a few adhesions here and there, the spleen can be lifted up so that the vascular pedicle lies completely exposed for at least two inches.

*Pancreas*—The splenic pedicle should be searched for the tail of the pancreas which, if present, will lie in the pancreatic notch of the spleen, behind the hilum. It can usually be readily separated, a few ligatures applied to bleeding points, and then dropped back into the abdomen. In three splenectomies, I<sup>2</sup> tied off a portion of the tail of the

pancreas with the splenic pedicle, in one case removing as much as an inch and a half, without any harm resulting. The spleen was bleeding so freely from lacerations that time could not be spared for separation. In the third case, in which the splenic vessels were atheromatous and would not hold a ligature, I tied the splenic vessels together with the body of the pancreas about three and one-half inches from its tip with two ligatures of catgut, three-fourths of an inch apart. The patient recovered without serious symptoms.

The pancreas has five independent sources of blood supply which protect its circulation. The pancreatic ducts have been shown clinically and experimentally to have great powers of regeneration. Fat necrosis as the result of escaping pancreatic secretion from injury to the pancreas in this situation, apparently is not to be greatly feared, probably because its secretions are not activated by duodenal secretion.

*Vascular Pedicle*—In the average case, the vascular pedicle can be so thoroughly cleared that it may be easily ligated in sections. The artery should be tied first, but all vessels should be tied before any portion of the pedicle is cut. In spite of this precaution the spleen sometimes tears from the pedicle before it can be ligated. This accident happened in one of my cases—a fleshy patient. The spleen had a short pedicle which retracted deeply, but I was able to grasp the vessels in my fingers and hold them until forceps could be applied. In this type of case it is better to grasp the entire pedicle with elastic rubber-covered clamps<sup>3</sup> which will temporarily compress without damage any attached viscus, such as the wall of the stomach, until the splenic vessels can safely be controlled. In two instances I have injured the stomach because of its close attachment to the splenic pedicle, in one case ligating a portion of the wall of the stomach in the pedicle. Fortunately there was no escape of gastric contents and I was able to repair the damage. The patient recovered. In the second case I was less fortunate. There were large varicose veins in the gastrosplenic ligament and, in making a thorough exposure of the pedicle, one of the veins in the wall of the stomach was torn. Unfortunately, tooth-forceps were used to grasp the vessel and the fragile gastric wall was lacerated. There was an escape of gastric contents into the bed from which the spleen had been enucleated and the patient died a few days later from sepsis.

When the vascular pedicle has been carefully exposed but is too short for accurate ligation of the vessels, the two-forceps method will be found very satisfactory. In this procedure, two forceps are placed three-fourths of an inch apart on the pedicle and the spleen cut away

without regard to back bleeding. A catgut ligature is thrown around the pedicle, below the proximal forcep, which is then loosened and the ligature tied in the compressed area, while the distal pair of forceps steadies the pedicle and prevents retraction. A second ligature makes the pedicle secure.

There are undoubtedly some cases in which splenectomy is indicated but in which the condition of the patient or the attachments of the spleen make the operation inadvisable.

Two years ago I<sup>3</sup> suggested the possibility of ligating part of the vessels, believing that it would have an effect comparable to the ligation of the thyroid vessels in hyperthyroidism. I have not had an opportunity to carry out this suggestion and am not at all sure that it could be done with any degree of accuracy unless the delivery of the spleen were accomplished and in that event splenectomy would be equally easy and more effectual.

John Gerster<sup>4</sup> has suggested ligation of the splenic artery at the celiac axis as a preliminary step in splenectomy, or in some cases as a method of producing atrophy of the spleen when it would not be practicable to remove it. He has mentioned the ease with which the celiac axis can be reached through the gastrohepatic omentum. The splenic artery certainly could be conveniently tied at the celiac axis, or just where it lies at the superior border of the pancreas.

Experimental ligation of the splenic artery demonstrates that the normal spleen will not become necrotic, but that it will undergo atrophy. The blood supply from the splenic artery to the pancreas and stomach which would be cut off by ligation is not important and would be well taken care of from the numerous anastomotic branches of other sources.

*Closure of the Splenic Space*—This procedure is exceedingly important. Compression with the large temporary tampon will enable the smaller vessels to become sealed in a few minutes, but in the deeper recesses of the wound, there will probably be vessels requiring other treatment. With catgut on a small curved needle, the raw space, beginning at the tied splenic vessels, is closed as well as possible. The margin of the lienorenal ligament, on the outer side, is sufficiently firm to hold a suture, but on the inner side such bits of tissue must be caught here and there, as can be done safely until the bleeding vessels are compressed. The last sutures come well down on the diaphragm and had best be applied during cardiac diastole and during expiration. In some cases the splenic space will be dry when the tampon is removed and suturing is not necessary. To be able to leave the wound dry is a great satisfaction and well worth the little extra time taken to accomplish

it One of my patients died of so-called secondary shock, due to failure to control hemorrhage at a deep point, and in two of my earlier cases, before I understood the value of the snaking catgut suture, I was compelled to leave a large tampon to control the oozing (Fig 2)

Drainage is not needed unless there has been injury to some viscus The after care is quite the same as that following any abdominal operation

*Mortality of Splenectomy*—The mortality of splenectomy depends more on the type of case accepted for operation than on the technical difficulties of the operation itself If the patient is in good general condition, a small, movable spleen can be removed with a death rate so low as to be almost accidental If the spleen is enlarged but has considerable latitude of motion, splenectomy may be performed with almost no mortality beyond the possible accidents of a serious operation But if the spleen is enlarged and adherent and the patient is suffering from a high grade of anæmia with myocardial and renal changes, marked by œdema of the lower extremities, or is suffering from ascites, jaundice, high temperature, etc, the mortality will necessarily be high Even under these conditions, surprisingly few patients die directly as the result of the operation In 14 of our patients œdema of the lower extremities was marked Seventeen had ascites with coincident myocardial and renal changes, 7 were jaundiced, and 5 were suffering from high temperature at the time of the operation There were many combinations of these conditions, all in connection with high grades of anæmia, yet there were but 5 deaths in the hospital from all causes, in the 58 cases operated on As shown by the post-mortem, 2 of the 5 deaths were from preventable causes (hemorrhage and sepsis) In conclusion, I desire to express my early indebtedness to J Collins Warren<sup>5</sup> for his splendid paper, "Surgery of the Spleen," stimulating interest in the subject

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# CAVERNOUS ANGIOMA OF THE SPLEEN \*

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THE surgery of the spleen has been developed largely in the effort to modify certain complex diseases in which splenic inflammation or splenic enlargement is believed to be a factor, hence the great majority of splenectomies in recent years have been done for splenic anæmia.

There is, however, a very distinct literature on splenic cysts, splenic angiomas and splenic sarcomas. The borders of these three divisions are not definite, for some splenic angiomas have ruptured so as to form blood cysts and have been described under that heading, and others have undergone such changes as to be classified under sarcomas.

Powers,<sup>1</sup> Huntington,<sup>2</sup> Johnston,<sup>3</sup> and Musser<sup>4</sup> made valuable contributions to the subject, 1906-1911.

In 1913, Fowler<sup>5</sup> published an exhaustive study of cysts of the spleen. He follows the generally accepted classification into dermoid, parasitic and non-parasitic cysts. He confines his study mainly to the non-parasitic variety, of which he analyzes 82 cases, all that he could find recorded either from autopsies or from surgical clinics. In this entire series, only 2 were regarded as due to angiomas. This indicates the extreme rarity of cysts due to angiomas.

If we look for records of non-cystic angiomas we still find them very uncommon. Only 10 such records have been found which could fairly be included in the accompanying table.

*Case Report*—The patient who forms the basis of this report was operated upon several years ago. The report was not then published as it was hoped that other similar cases would be observed. The extreme rarity of the condition, however, makes this unlikely, and, hence, it is offered as one member in the group of papers on the surgery of the spleen, which has been arranged for this meeting.

The patient, a well-nourished woman of thirty-seven, was admitted to the General Memorial Hospital, March 27. Her family and personal history had been negative excepting that 4 years previously a tumor had been removed from her neck, apparently a thyroglossal cyst. She had borne three children.

For six months she had suffered from pain in the splenic region. During a period of a week, two months ago, she had

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\* Read before the American Surgical Association, June 9, 1915.

suffered from repeated attacks of vomiting and epigastric pain, no blood in vomitus or stools Three weeks ago she had noticed a lump in splenic region which had steadily increased in size On admission to the hospital it had reached the proportions shown in Fig 1

Its margin was round, its consistency firm and it moved with respiration There was no clinical evidence of abnormality in other organs

*Operation* (April 1) —The mass was found to be a greatly enlarged spleen which was removed It was adherent to the surrounding tissues and contained about 3 pints of blood in the parenchyma of its upper end The so-called blood cyst thus formed was ruptured in removing the organ There was no lining membrane in the resulting cavity

The appearance of the specimen after shrinkage and hardening is indicated in Fig 2

Microscopical examination was made by Dr William C Clarke of Columbia University Sections were examined from various parts of the organ The spleen tissue had been practically replaced by a cavernous angioma

*Pathological Report* (by Dr Wm C Clarke) —Spleen measures  $20 \times 12 \times 7$  cm In the larger end there is a blood distended cavity measuring 10 cm in diameter This produces a bulging rounded mass that projects evenly at the upper end of the spleen The spleen surface is slightly lobulated and wrinkled throughout There are two notches on the border In the cut surface there are seen many hemorrhages in the splenic pulp Adjacent to the larger cyst there is a single large hemorrhagic area 4 cm in diameter Microscopical examination of the spleen shows there are very many blood spaces of large size through the specimen Between the large vessels are countless small ones In the stroma there are free red blood-cells, showing that there have been blood extravasations The stroma itself is scanty between many of the vessels and elsewhere it is exceedingly dense and cellular In none of the sections examined is it possible to find any true splenic tissue intact, at points there are small aggregations of round cells suggesting lymphoid tissue

To conclude, the bulk of the spleen is made up of blood-vessels and stroma to which is added extravasated blood

Diagnosis "Cavernous angioma of the spleen"

Figs 3 and 4 indicate the appearance of the microscopical specimens

At the operation many small, dark, cyst-like spots were noticed on the under surface of the liver, they were about  $\frac{1}{4}$  inch in diameter, dark blue in color and appeared to contain small amounts of fluid They were not elevated above the surface of the liver

The subsequent history of the patient is most noteworthy and shows the sad possibilities of this type of tumor

Her immediate recovery from the operation was satisfactory,

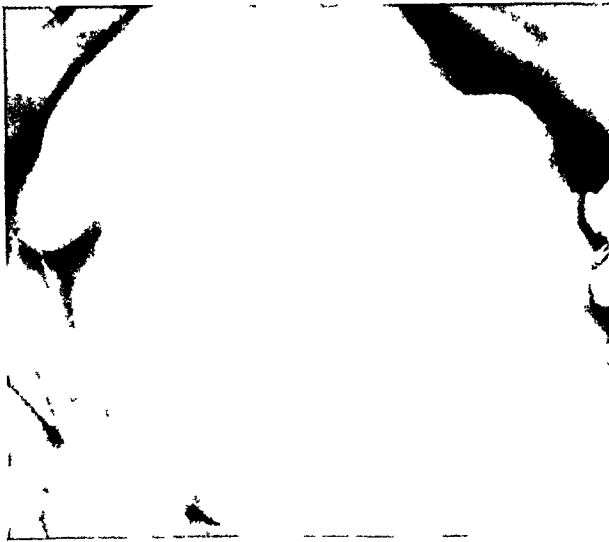


FIG 1 —Showing outline of tumor as palpated through abdominal wall



FIG 2 —Drawing of spleen after shrinking and hardening. The spleen is shown in two parts, the central part replaced by cavernous anoma





FIG 3—Microphotograph of cavernous angioma of spleen (low power)

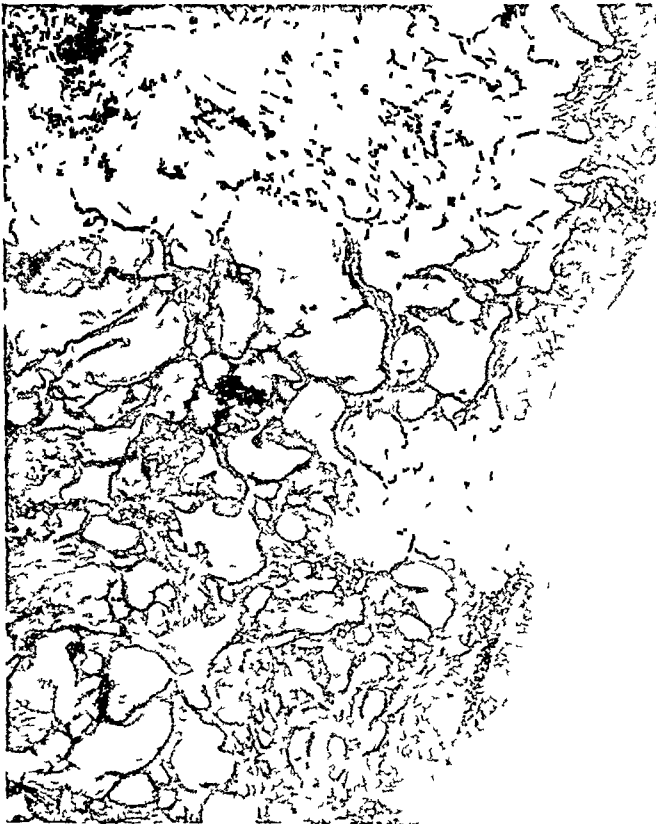


FIG 4—Microphotograph of cavernous angioma of spleen (high power)

## CAVERNOUS ANGIOMA OF THE SPLEEN

and on the twelfth day she was permitted to sit up. On the evening of the thirteenth day she had an attack of pain in the epigastrium and right hypochondrium and felt faint. The liver was enlarged and over it there was fremitus on respiration. It was believed that she had suffered a liver hæmorrhage similar to that which had previously occurred in the spleen. She was kept in bed, horse serum was injected and she improved steadily for about a week, when the symptoms were repeated, and they came on again two weeks later. By May, her condition had become alarming: her pallor was extreme, she had moderate jaundice, and was very weak. Her red blood-corpuscles numbered only 699,200 per cubic millimetre and her hæmoglobin was only 25 per cent of the normal. Transfusion was done and the hæmoglobin percentage raised to 40 per cent. This was followed by improvement, but by May 20, her people were discouraged and took her home where she died during the following month.

Before she left the hospital, there were signs of fluid in the lower part of the right side of the chest and bloody fluid was obtained by aspiration. The liver also showed much enlargement. It could be felt within one inch of the umbilicus. Ecchymotic discoloration also appeared about the site of the incision.

The following 15 blood examinations are recorded by members of the house staff, April 2 to May 20.

	Hæmo- globin percent- age	Red blood- cells per cubic millimetre	White blood- cells per cubic milli- metre	Poly- morpho- nuclears and transi- tionals	Eosino- philes	Baso- philes	Large lym- pho- cytes	Small lym- pho- cytes
April 2	70	4,448,000	30,600	88.3	5	6	37	15
April 3	70		28,000	88	0	0	7	5
April 4	70	4,960,000	17,600	87	0	0	9	4
April 5	70	4,572,000	9,200	74	3	0	7	16
April 6	70	4,375,000	10,200	73	2	0	6	19
April 7	65	3,325,000	14,130	73	1	0	6	20
April 10	60	2,756,000	14,180	76	1	0	5	18
April 14	70	3,280,000	13,500					
April 21	55	3,232,000	17,860	83		2	7	11
April 28	45	1,136,000	25,000	91	0	0	8	1
May 6	25	699,200	22,230	91	0	0	2	7
May 10	40							
May 12	40	1,904,000	22,800	86	0	0	5	9
May 13	35							
May 20	35	864,000	23,600	88	0	0	2	10

It is noticed that her anaemia became progressively worse and that she had a decided leucocytosis.

The main interest in this record centres in the growth which led to these overwhelming symptoms. Cavernous angiomas of the spleen with metastasis in the liver are very uncommon.

Jores,<sup>6</sup> in describing such a case in 1908, states that he is able to find records of only two other cases, those of Langhans and Theile

In searching the literature, we have included in the accompanying table those cases which seem to bear directly on the subject. Some of the autopsy cases, however, showed very slight lesions. It is possible that under different headings records of other important cases exist, but this table is the result of many hours of search in the library of the Academy of Medicine by Dr Charles E Farr, and two weeks of continuous work there by Mr Charles W Lester

The case of Langhans,<sup>7</sup> which was recorded in 1875 and which has been very extensively quoted through the intervening years, is almost the counterpart of the one here recorded. A robust acrobat aged thirty had a sudden pain in the splenic region and developed a pulsating angioma which involved nine-tenths of the splenic tissue and reached a size of  $23 \times 15 \times 10.5$  centimetres. This was accompanied by metastasis of a similar nature in the liver which reached 3 or 4 times its normal size. He died after  $4\frac{1}{4}$  months from exhaustion and suffocation.

Jores' case was also similar, a woman of forty-five who had a cavernous angioma of the spleen with liver metastasis. Death after 11 months from dropsy and cardiac weakness.

In Homan's case, it was believed that the omentum was also involved.

In Ernst's case, a child of  $1\frac{1}{4}$  years, the liver was more involved in the angioma than the spleen, and there were 85 angiomatous spots in the skin.

In Theile's case the liver, stomach and lungs were involved.

Thus we see that in 6 of the 13 cases the spleen was not the only organ involved in the angiomatous growth.

Three of the remaining cases (Martin, v Benkendorf and Anzilotti) recovered from their splenectomies and it is uncertain whether they had involvement of other organs.

The other 4 cases (Albrecht, Theile and Lubarsch) were reported from autopsies. The angiomas were small, no history of symptoms is given and there is no mention of angioma in other organs in 3 of the cases, the 4th died from perforation of the gall-bladder. They are included in the tables as minor grades of spleen angioma.

*Histogenesis*—In connection with the published reports much has been written about the histogenesis of these growths. If we follow Moschcowitz,<sup>8</sup> who made an analogous study of cysts of the liver, we

# TABULATION OF CASES WITH CAVERNOUS AN

No	Observer	Reported	Sex	Age	Duration	Symptoms	Op
10	Theile	Virch Archiv Bd 178, p 296	M	62		Autopsy report by Lubarsch, S 75, 1903	
11	v Benkendorf	Virch Archiv, Bd 194, p 500	M	53	2 years	Abdominal swelling Tumor felt	Splenect
12	Anzilotti	Lo Spermantale, Archivio de Bi- ologia, Suppl vol 67, 1913, p 161	F	38	14 months	Severe epigastric pains not related to meals often ter- minating in vom- iting Blood ex- amination red- 4,580,000, whites 4700, hæmoglobin 100 per cent few platelets Urine negative as to ab- normalities Leu- cocytois follow ed operation lasting 45 days Increase in platelets	Splenect
13	Dowd.		F	37	6 months	Pain in splenic region Vomiting and epigastric pain Lump no- ticed in splenic region, increasing in size	Splenect

# GIOMA OF THE SPLEEN    PREPARED BY CHAS W LESTER—*Continued*

ation	Result	Pathology	Involvement of other organs
		<i>Spleen</i> Normal size Greenish protuberances on surface Firm dark red protuberance at upper pole bean-sized Smaller knot inside spleen Several knots at lower pole Tumors have same appearance as in preceding cases but richer in thrombus and spindle cells Diagnosis Obliterating angioma	<i>None</i> Cysts in kidney and oesophagus
omy	Not reported	<i>Spleen</i> Large cavernous area replacing three-fourths normal tissue Sharply marked off from normal tissue Venous capillaries enlarged lengthened and walls thinned Pulp between capillaries compressed and contains follicles and trabeculae Cavern contains lymphocytes pulp cells, red blood-cells and colloidal substance	None
omy	<i>Recovered</i>	<i>Spleen</i> Weight 1 kg Several elevations on surface size of walnut, cyanotic color In part cyst-like communicating structures lined with endothelium Elastic fibres present Were filled with fluid, blood clots, fibrin, or hyalin masses Blood spaces dilated, pulp atrophic Other localities showed transition into lymph tracts Cross-section showed numerous angiomata giving cavernous structure Malpighian corpuscles altered, trabeculae thickened	None
omy	Died 2½ months later from hemorrhages in angioma of liver	<i>Spleen</i> Measured 20×12×7 cm Blood-distended cavity 10 cm in diameter at larger end Two notches on border In cut surface many hemorrhages in splenic pulp Adjacent to larger cyst is single hemorrhagic area 4 cm in diameter Microscopical Many large vessels with small ones between Free blood-cells in stroma Stroma scanty Diagnosis Angioma of the spleen	

find that studies in histogenesis have conformed to one of three theories (1) inflammation, (2) tumor formation, (3) maldevelopment

The inflammation theory represents the work of the older pathologists and was developed before bacterial infection was considered as important as we now believe. Virchow, for instance, wrote of intra-uterine inflammation due to chemical irritation or mechanical obstruction. The painstaking description of the histological findings and the importance which is ascribed to blood-pressure and congestion and occlusion of vessels indicates a belief that some inflammatory change has been an element in the production of these growths. The writers, however, have been unable to give satisfactory evidence of such change.

As to the second, it is to be noticed that Jores found, in parts of his specimen, tissue resembling spindle-celled sarcoma, and hence used the term sarcomatous angioma.

Theile found in his case sarcomatous areas in the spleen, liver, lungs and stomach, and also used the terms angioma and sarcomatous angioma.

In most of the cases, however, there is no proof of sarcoma, the tumors are reported as angiomas and must be so regarded. They certainly have not shown the characteristics of malignant tumors.

If, however, we study the cases on the theory of maldevelopment, we have an explanation which at least is more plausible and more easily understood than either of the others. We are accustomed to observe congenital cutaneous and subcutaneous angiomas. Occasionally we find that they take on unexpected and even extensive growth, why they do so we do not know, but since the tissues themselves are abnormal, it does not seem very remarkable that their growth should be peculiar. We can better understand the existence of these angiomas on this basis than on any other which has been advanced.

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## ABSCESS OF THE SPLEEN\*

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A CAREFUL study of the literature, especially that of recent years, has conclusively shown that abscess of the spleen, usually regarded as more or less of a pathological curiosity, is of much more frequent occurrence than is ordinarily assumed. The occurrence of abscess of the spleen has been recognized from the earliest history of pathology and surgery, and reports of such cases come from all parts of the world. The condition, however, appears to be most frequently observed in the warmer climates, doubtless due to the more frequent occurrence of typhoid fever, malaria and dysentery. Abscess of the spleen has been known to follow typhoid fever, malaria, dysentery, relapsing fever, yellow fever, pyæmia, endocarditis, influenza, dengue, smallpox, diphtheria, anæmia, filariasis, and leukæmia. In short, it may follow any acute infectious disease, especially those associated with acute splenic tumor. Instances have also been reported in which spleen abscess has been secondary to appendicular abscess, salpingitis, puerperal fever, gangrenous chancre, carbuncle, and wounds of the external surface of the body. Any focus of infection may therefore be the portal of entry for the micro-organisms which may eventually produce abscess of the spleen. It has also been known to follow trauma as well as the twisting of the spleen pedicle in the so-called "wandering spleens." In a considerable number of instances, the portal of entry for the infecting micro-organisms has never been demonstrated and the symptoms referable to the spleen have dominated the entire picture. Abscess of the spleen always results from contiguous or metastatic infection, the latter being by far the more frequent. The instances in which spleen abscess has resulted from extension of infection by contiguity are comparatively few and have been associated for the most part with perforations of the stomach or subphrenic abscesses on the left side. It is also highly probable that a considerable number of cases reported as left subphrenic abscesses have been in reality abscesses of the spleen in which the involvement of the spleen has not been recognized. It certainly seems to be the fact that in the great majority of instances, intraperitoneal abscesses below the diaphragm on the left side are either abscesses of the spleen or have their origin in such abscesses. In many of the reported cases, no mention is made of the bacteriology of the abscess, but in a very con-

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siderable number the pus has been carefully studied and accurate reports made. In some instances, the abscesses have been shown to be sterile, while the bacteriology of those in which micro-organisms have been found has been very varied. Practically all the pyogenic bacteria, except the gonococci, have been described in connection with such abscesses, namely, bacillus typhosus, bacillus coli communis, streptococcus pyogenes, staphylococcus pyogenes aureus, pneumococcus, bacillus pyocyaneus and proteus mirabilis.

Considerable difference of opinion has existed as to the mode of development of the abscess in the spleen, many writers having regarded the abscesses as of embolic or thrombotic origin, originating in the infarcts, resulting from such emboli or thromboses. The frequent occurrence of such infarcts has been a strong argument in favor of this view, especially as such infarcts are known to occur in the interior of the spleen as well as upon the surface. Litten has especially emphasized the importance of thrombotic hemorrhagic spleen infarcts in the etiology of spleen abscess. Others are inclined to the view that abscess of the spleen may result from the activity of micro-organisms deposited in the spleen without the formation of infarcts. It would seem very probable that both views are correct, but it would appear that the greater number of spleen abscesses result from infected infarcts.

It very frequently happens that the cause of the enlargement of the spleen is not the direct cause of the abscess. Any condition which causes splenic enlargement may render it a *locus resistantiæ minoris* and, under such conditions, micro-organisms may gain a foothold which would otherwise cause no trouble. This is certainly the explanation of the occurrence of spleen abscess in association with or after malaria, leukaemia and other diseases associated with a chronic enlargement of the spleen.

Typhoid fever is undoubtedly the most common single cause of abscess of the spleen and the reason for this is quite evident, associated as it probably always is with an acute splenic tumor and occasionally with infarcts and hemorrhages in the spleen, as evidenced by Curschmann's findings of 25 cases of infarct and hemorrhage in 557 autopsies on individuals dead of typhoid fever. In the 557 typhoid autopsies reported by Curschmann, there were 4 cases of abscess of the spleen. Berg, of Leipsic, in an epidemic of 1626 cases of typhoid fever with 243 deaths and 228 autopsies, observed 4 cases of spleen abscess, while Vierhoff in Riga, in 1186 cases of typhoid with 112 deaths, saw 3 cases of spleen abscess. The severity of the infection does not appear to play a rôle in post-typhoid spleen abscess. In fact, Melchior states



that this complication is more frequently seen after the mild or moderately severe cases. There is often an afebrile period between the cessation of the typhoid fever and the onset of splenic symptoms. In many of the reported cases pure cultures of bacillus typhosus have been obtained from such spleen abscesses, while in other instances other pyogenic organisms have been found and in still other instances of post-typhoid spleen abscess the pus has been sterile.

Malaria probably comes next to typhoid fever as a factor of etiological importance in the causation of spleen abscess, but the views in regard to this are somewhat at variance, some authors claiming that spleen abscess in association with malaria is not especially infrequent, while others believe that it is very infrequent, as, for instance, Chowdhury, who observed only 3 cases of abscess of the spleen in 30,000 cases of malaria in India. Italian writers have, however, reported a considerable number of cases in association with malaria, and its etiological importance is certainly established beyond question. Kernig, in 400 cases of relapsing fever in 1864-1866, observed 5 cases of abscess of the spleen, and Petrowski, in 359 cases of relapsing fever, saw 3 cases of spleen abscess. Ponfick, in a series of autopsies on cases dead of relapsing fever in one epidemic, found infarcts of the spleen in 40 per cent of the cases.

Trauma is always of etiological importance both in normal spleens as well as those pathologically enlarged, and there are a considerable number of cases in the literature in which the direct relationship of trauma to spleen abscess has been conclusively shown.

Kuttner has especially emphasized the importance of what he calls "sequestrating spleen abscess," a suppurative process, which is characterized by the presence in the pus of sequestra of spleen tissue. This condition, which occurs so often in abscess of the spleen, is but very rarely observed in abscess of the other abdominal organs and is regarded as of distinct diagnostic significance. The size of the sequestra may vary from minute bits to practically the entire spleen. Kuttner in 1907 collected 116 cases of spleen abscess, 2 of which were in his own experience, and of this number 43, or 37 per cent, were of the sequestrating variety. The etiology of these 43 cases was grouped as follows:

1 Traumatic origin, 6 cases	14 per cent
2 Septic general infection, 11 cases	25.28 per cent
3 Post-typhoid spleen abscess, 6 cases	13.95 per cent
4 Post-malarial spleen abscess, 7 cases	16.28 per cent
5 Associated with twisted pedicle of wandering spleen, 2 cases	4.65 per cent
6 Following perforation of the stomach, 3 cases	6.97 per cent
7 Cases of doubtful origin, 8 cases	18.6 per cent

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Kuttner conducted a series of experiments on dogs, and demonstrated that laceration of the spleen as well as infarcts may be the starting point of sequestrating spleen abscess. Kuttner states that the presence of spleen tissue in a left-sided subphrenic abscess is proof positive of the existence of a sequestrating spleen abscess.

The symptoms of abscess of the spleen are in many cases not distinctive and can only be said to be suggestive. Enlargement of the spleen, as demonstrated by percussion or palpation or both, is practically always present, but this is of such frequent occurrence in many acute and chronic diseases without abscess that a great deal of importance cannot be attached to it. If the abscess is confined to the interior of the spleen no distinctive and almost no suggestive symptoms are present. It is only when the abscess reaches the capsule of the spleen and begins to cause disturbance in surrounding tissues that attention is especially directed to the splenic area. The local findings will differ according as the upper or lower pole of the spleen is more involved. If the abscess is in the lower pole, the spleen tumor will usually present below the costal margin and can be palpated. If the upper pole is involved, the diagnosis is more difficult and subphrenic abscess must be considered. One of the earliest and most constant symptoms that accompanies this stage of the disorder is pain, either spontaneous or elicited by pressure over the enlarged spleen. In many cases pain of this character is the only symptom complained of for a long time. Inflammatory involvement of the diaphragm and the pleura at the base of the left pleural cavity is one of the most important and suggestive symptoms of spleen abscess. This may lead to more or less restriction of movement of the left half of the diaphragm or an abnormally high position of the diaphragm on the left side, which can often be demonstrated by the fluoroscope or radiograph. A radiograph may give a very definite indication of a subphrenic or splenic abscess as in the case reported by the writer, and is of the greatest value in determining the diagnosis.

Pleurisy at the base of the left pleural cavity is a very common accompaniment of spleen abscess. It may be simply a dry friction or it may be a serous, serohemorrhagic or even purulent pleurisy, and in a considerable number of cases the condition has been regarded as one of pleurisy or empyema, and the origin of the process in the spleen has not been suspected until at operation or autopsy.

Fever of a remittent or intermittent type is a fairly constant symptom, although there are a number of cases in the literature in which there has not been any elevation of temperature above the normal.

Irregular chills have been noted in many cases. Leucocytosis of a rather pronounced character, from 20,000 to 50,000, has been frequently noted and especially emphasized by some writers as a diagnostic point of great importance, but in some cases there has not been any increase in the leucocytes, depending, of course, on many factors such as encapsulation of the abscess, reduced vital resistance, nature of the toxins, etc., so that this cannot be regarded as a constant sign. Nausea, vomiting and diarrhoea have been noted in not a few of the reported cases of spleen abscess. In a few instances œdema of the intercostal spaces over the splenic area has been noted. Exploratory aspiration is of the greatest importance in arriving at a diagnosis, and, while this practice has been decried by a few observers, the great majority unite in the belief that it is the most efficient method available for the determination of the diagnosis. It not only establishes the diagnosis, but gives a positive and definite indication for operation. Melchoir collected 17 cases of abscess of the spleen following typhoid fever, in all of which exploratory aspiration was practised without any untoward effects whatever, nor has it been possible to find in the literature any cases in which there is evidence that any bad effects have followed the employment of this procedure. It is also very evident that had it been used at an earlier stage of the disease, it would have been possible to establish the diagnosis in many cases at a time when treatment would have been more efficacious. Once the diagnosis is established, the only rational treatment is surgical, for, left to itself, abscess of the spleen usually results fatally, either from general sepsis or perforation into the peritoneal or pleural cavities, or some viscus. Spleen abscesses have been known to perforate into the stomach, intestine, pleural and peritoneal cavities, or even externally on the surface of the chest or abdomen, and in a few instances recovery has followed spontaneous evacuations of the abscess.

The surgical treatment is splenectomy or splenotomy, usually the latter. Splenectomy is to be employed only in such cases as are reasonably free from adhesions, or in which the organ can be removed without great difficulty or danger of spread of the infection. There are in the literature a number of successful cases of splenectomy for spleen abscess, but the great majority of the cases have been treated by splenotomy or drainage of the abscess cavity. The mode of operative procedure will depend upon the characteristics of the individual case, but will necessarily be through one of three routes: (1) the transpleural, (2) the abdominal, and (3) the retroperitoneal.

If the abscess involves the upper pole of the spleen, or presents the

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characteristics of a subphrenic abscess, the transpleural route will be the most satisfactory. The ninth, tenth or eleventh rib, usually the tenth, is resected in the posterior axillary line, and in many instances adhesion of the pleura will have occurred in that locality, so that incision of the diaphragm and drainage of the abscess can be satisfactorily accomplished without infection of the pleural cavity. If the layers of the pleura are not adherent, suture of the diaphragmatic and parietal pleura should be performed and the abscess opened through the diaphragm either in a one-stage or two-stage operation as demanded by the conditions. Such a procedure does not, of course, allow of a splenectomy unless the entire spleen should have become sequestered. The transpleural route is the shortest, but also the most difficult route to reach the spleen unless the pleural layers are adherent, when, of course, it is the ideal method.

The abdominal route is usually through an incision parallel to the twelfth rib, sometimes combined with resection of the twelfth rib. This gives free access to the spleen, especially if the abscess is located in the lower pole, or the spleen has been displaced downward. The danger from soiling of the peritoneum is comparatively slight and the opportunity for the establishment of drainage, or for splenectomy, if indicated, is excellent.

The retroperitoneal route has not been widely practised, but is strongly recommended by Propping. It consists in an incision between the anterior and midaxillary lines, extending from the tip of the twelfth rib along the lower margin of the eleventh rib. After severing the oblique muscles, one approaches the retroperitoneal or paranephritic tissues. The finger can be pushed along the under surface of the diaphragm towards its vault until the region of the abscess is reached and drainage established. If more room should be required, resection of the anterior part of the twelfth rib, or the anterior part of the eleventh rib can be done without much danger of opening the pleural cavity.

The prognosis of abscess of the spleen, recognized reasonably early and adequately treated surgically, is relatively good. Stucky places the mortality of reported cases at from 21 to 23 per cent. The best prognosis is afforded by the cases of spleen abscess following typhoid fever. In 22 such cases collected by Stucky, there were only 2 deaths, a mortality of 9 per cent. This is probably due to the fact that post-typhoid suppurations in general are relatively benign. The increased mortality in cases due to other causes is largely due to the nature or

continuance of the original disease, of which the spleen abscess is a complication

The following case observed by the writer is reported in detail because it emphasizes many of the essential features of spleen abscess

Mrs M , twenty-seven years of age, had always been well and healthy, and had had three children Some little time before the onset of the illness she was thought to have had an abortion performed, but no definite data as to this occurrence or its date were obtainable On June 11, 1914, while in apparently good health, she was suddenly seized with a sharp pain in the left upper quadrant of the abdomen The pain radiated to the back on the same side, the patient was nauseated, but did not vomit The pain was not relieved by evacuation of the bowels and on the following day it became more severe and the abdomen slightly distended She was up and about, and thought that she had some fever, although the temperature was not taken

On June 13 a physician was called, the pain was still very severe and there was marked tenderness and muscle rigidity over the region of the left kidney The spleen was not palpable and there was considerable abdominal distention, especially over the left upper quadrant The urine was blood-tinged and contained numerous red blood-corpuscles This, however, was not a catheterized specimen and the patient had been flowing slightly

From June 14 to June 17, there was a marked decrease in the pain and there was only a trace of blood in the urine

On June 18 the pain became much more severe, especially over the left lower quadrant of the abdomen and a fair amount of blood appeared in the urine This condition continued until June 20 when the patient was brought to the Albany Hospital There had not at any time been any cough or evidence of pulmonary disturbance On admission to the hospital, the temperature was 101°, pulse 110, respiration 20 The patient looked sick and complained of sharp pain over the left upper abdominal quadrant, radiating to the back The pain was not affected by respiratory movement of the chest There was tenderness over the left upper abdominal region and some abdominal distention but nothing abnormal could be palpated and the pelvic organs appeared to be perfectly normal The area of splenic dulness was somewhat increased and there was no muscle spasm in the left costovertebral angle, nor was there any other tenderness or evidence of disturbance in the abdomen The liver was not increased in size The heart and lungs were normal and there was no glandular enlargement or evidence of physical disturbance other than as noted The urine showed a

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trace of albumen and a few red blood-corpuscles. The leucocytes were 19,000.

On June 22, radiographs of the lower chest and abdomen were made, but were in every respect negative. During the succeeding days, the patient was greatly troubled with nausea and vomiting, with more or less intestinal distention and abdominal unrest.

On June 24, the ureters were catheterized and cultures from the urine thus obtained showed staphylococcus albus, which was probably a contamination. The urine contained a few red corpuscles, probably due to instrumentation, but no increase of leucocytes and no other abnormality. The Widal's for typhoid and para A and para B were all negative. From June 20 to June 30 the patient's temperature was irregular in character and ranged from 98.6 to 102.4° and the chief complaint was of pain in the upper left abdominal quadrant, nausea, vomiting and some distention. The area of splenic dulness increased and the edge of the spleen could be felt at the costal margin and pressure over this area was painful. The leucocytes ranged from 20,000 to 24,000.

On July 1, the temperature fell to normal with a general improvement in all the symptoms and for six days the temperature remained normal, with practically a disappearance of all symptoms except some slight pain in the region of the enlarged spleen. The urine was normal except for a slight trace of albumen, and the leucocytes on July 3 were 12,400.

Everything seemed to be progressing most favorably. The patient's appetite had improved and she was planning to return to her home, when, on July 7, the temperature went up to 100° and on the day following to 102.6°. There was a marked increase of the pain in the region of the spleen and the nausea and tympanites returned. The only physical evidence of abnormality aside from the tympanites was the enlarged spleen and pain on pressure in this region. The leucocytes on July 9 had risen to 22,400. All of the Widal's on July 11 were again negative. Blood cultures on July 13 were negative.

July 14, the patient for the first time complained of being chilly. The patient's temperature had assumed a remittent septic type and the spleen had become more enlarged and could be readily palpated two centimetres below the costal margin.

July 17, dulness in the midaxillary line extended upward to the ninth rib, but aside from the dulness and absence of breath sounds in that region, there was no evidence of any pleural or pulmonary disturbance. Exploratory aspiration was done in the

ninth interspace in the posterior axillary line and only blood obtained. The leucocytes were 22,400.

From July 17 to August 4 the patient had frequent slight chills and her temperature, which was of a remittent type, ranged from 98° to 104°. There was considerable nausea and vomiting with tympanites and the patient was evidently losing ground. Numerous Widal's were done and on one or two occasions were reported as suspicious for typhoid. All of the signs pointed to the splenic region where the patient complained of all her pain.

August 2, exploratory aspiration was again done through the ninth interspace in the posterior axillary line, but was negative.

August 4, a radiograph was made, which showed an arching upward of the diaphragm on the left side posteriorly as far as the middle of the eighth interspace. Both pleural cavities were normal. Below the diaphragm there was an irregular area of shadow extending from the ninth to the eleventh ribs inclusive, posteriorly and to the outer side of the abdominal cavity corresponding to the position of the spleen. Over a part of this shadow was the shadow of a coil of intestine containing gas, probably the splenic flexure. Exploratory aspiration was again employed in the tenth interspace posteriorly into the area of shadow indicated by the radiograph and this time pus was located at a considerable depth. A portion of the eleventh rib was resected posteriorly by my assistant, Doctor Donhauser, during my absence from the city and a small abscess deeply seated below the diaphragm was opened. Cultures from the pus showed a pure culture of pneumococci. There were, however, absolutely no signs or symptoms of pleural or pulmonary involvement. Following this operation the patient's general condition seemed to improve and for a few days the temperature was not quite so high, but after a few days she began to lose ground again, had chills and profuse sweating, with nausea and tympanites.

August 20 another blood culture was made and reported as negative. Mixed vaccines were then employed and continued for some time without any appreciable effect. The drainage from the wound diminished.

August 24 another radiograph was made, which showed both pleural cavities normal and a much less distinct shadow where the abscess had been opened in the left side.

August 27, for the first time, the patient began to complain of pain in the liver region and the liver was found to be somewhat enlarged and rather sensitive.

August 28, for the first time, the patient coughed a little, but no evidence of any pleural or pulmonary disturbance could be found.

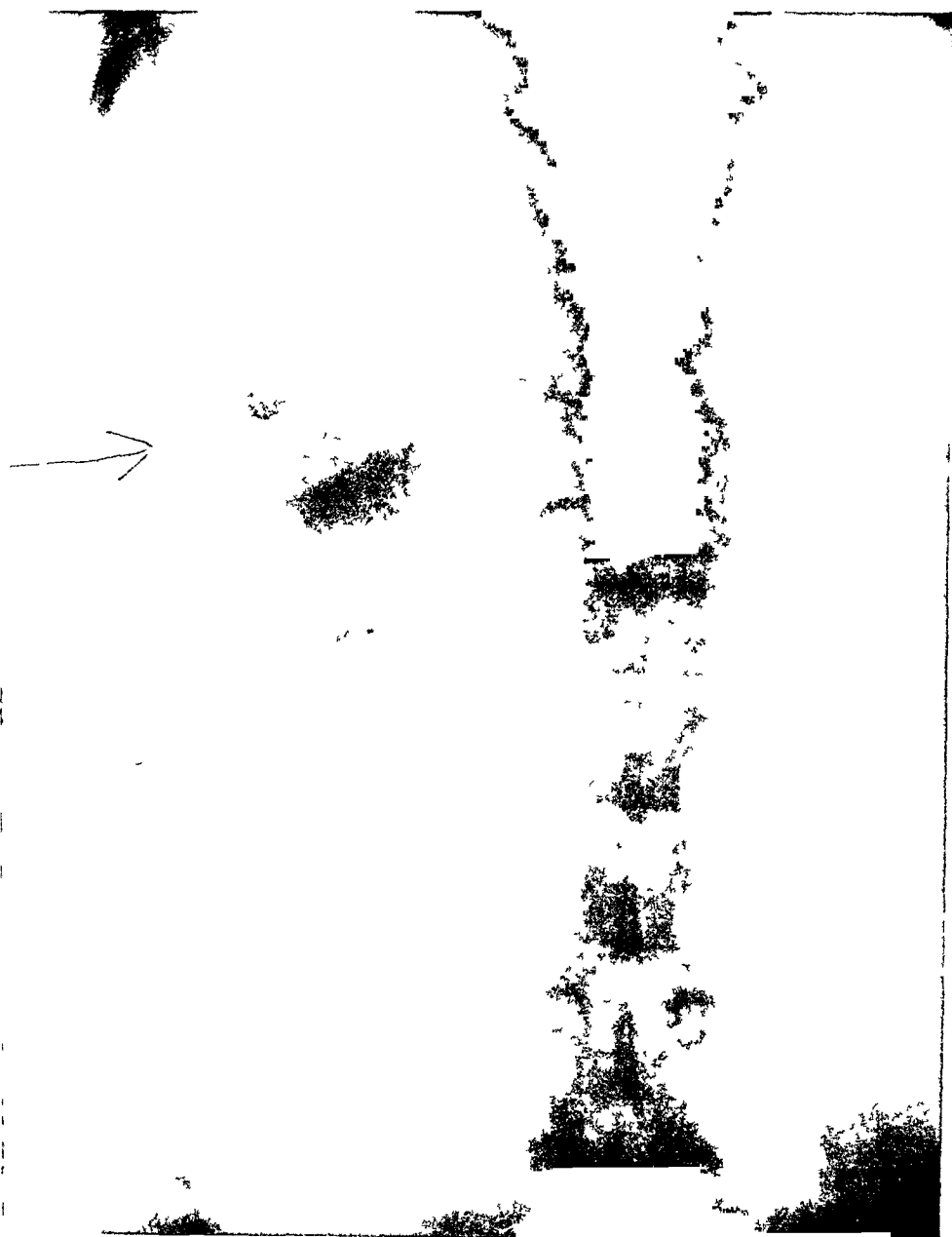


FIG 1 —Showing arching upward of diaphragm on left side with shadow of splenic abscess below diaphragm—indicated by arrow





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On August 29 it was felt that an opportunity for freer drainage of the left side was desirable and the writer resected a considerable area of the tenth rib as well as more of the eleventh rib and followed the track of the sinus through the diaphragm into the spleen, which was found to be riddled with abscesses, with some areas of sequestered splenic tissue, the largest of which was the size of a walnut. These areas of tissue, examined at the Bender Laboratory, were reported as "acute splenitis." Very free drainage was thus established and profuse discharge occurred during the succeeding days. The patient's condition, however, grew steadily worse. She complained of much pain over the region of the liver and the liver became much enlarged with some icterus. She presented the appearance of a suppurative portal pyelophlebitis, which she was believed to have as a complication of the spleen abscess. Occasionally the patient would have attacks of coughing with some mucus, or mucopurulent, expectoration. She grew steadily weaker, the temperature ranging from 96.8° to 104.8°, until on September 20 she had a sudden attack of pulmonary oedema associated with the expectoration of a considerable quantity of mucopurulent material and died. An autopsy could not be obtained.

Unfortunately the original portal of entry for the micro-organisms in this case could not be positively demonstrated, but the fact that an abortion was thought to have been performed a short time before the onset of the disease would indicate that possibly the uterus was the portal of entry and that the case might be classified as a spleen abscess secondary to puerperal infection. The pronounced intestinal symptoms early in the disease as well as subsequently necessitated the consideration of the intestine as a possible portal of entry. There is also the possibility that the primary disturbance may have been an hæmatogenous infection of the left kidney, which soon cleared up. The enlargement of the spleen developed in the early stages of the disease and persisted, although somewhat reduced in size, during the afebrile period of six days when the patient appeared to be on the road to recovery. The recrudescence of fever was doubtless due to the splenic infection, which escaped detection from July 8 to August 4 in spite of the most careful examinations and repeated exploratory aspirations of the area of the splenic dulness. When finally the abscess was located by radiograph and aspiration, the infectious process had gone too far to be favorably influenced by surgery, in spite of the vigorous efforts made to provide free drainage. The final picture presented by the case was one of portal pyelophlebitis in all probability.

secondary to the abscess of the spleen. It seems quite reasonable that had an exploratory laparotomy been done in the earlier stages of the disease and the splenic area carefully examined and properly treated, a more favorable outcome might have been had, but the acute splenic tumor so common in acute infectious processes hardly seemed a sufficient justification for such a procedure.

It is to be hoped, however, that the study of such cases as this will lead to the earlier exploration of the splenic region in cases which present such definite subjective and objective symptoms as those here related.

# PAPILLOMAS OF THE GALL-BLADDER<sup>1</sup>

BY CHARLES H. MAYO, M.D.

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FEW new operations on the gall-bladder have been developed recently. Very early in the surgery of gall-stones cholecystotomy, cholecystostomy and cholecystectomy were common procedures, some surgeons advocating one and some another.

Later, exploration of the ducts, especially in cases in which jaundice was or had been a factor, was practised by some surgeons who reported an unusually large percentage of cases of common duct disease, as primary instead of secondary surgical procedures, such examinations also disclosed pancreatitis of some form as an occasional complication. Pancreatitis had been considered a rare disease by those who did not explore and whose knowledge was derived from autopsy reports. Such explorations at the operating table led to the cure of a larger percentage of cases, many patients being saved time and dangers of a second operation. The same can be said of examinations of the appendix for associated disease at operations on the stomach and duodenum for ulcer.

In an early day surgeons were often chagrined in operating for gall-stones to find no evidence of stone, but an apparently healthy gall-bladder. In these cases general exploration was forced upon them and thus the advantage of always exploring, when not contra-indicated, became an accepted routine of abdominal operations. Cholecystitis associated with stone formation was commonly noted. Thick-walled gall-bladders without stones, but giving symptoms of cholecystitis, were next drained or removed. Stones were occasionally found in thin-walled and blue gall-bladders which, when free from adhesions, formerly had been considered free from disease. Some such gall-bladders, upon cholecystostomy, showed the peculiar markings of "strawberry" (Fig 1) mucosa. It was then appreciated that a disease of the mucosa could exist in a gall-bladder which from its external appearance was apparently healthy. In cases in which well-marked symptoms of gall-bladder disease existed the gall-bladder was opened, examined and drained, or removed according to the personal judgment of the operator after he had proved to his satisfaction that the symptoms were not caused by other abdominal conditions. Such gall-bladders were described as "catarrhal," a term which always leads one to think of an excessive mucous secretion or of a mucosa with a diseased surface, but which really means inflammation at the base of the cells involved.

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<sup>1</sup> Read before the American Surgical Association, June 10, 1915

If an inflammation is from bacterial infection the lymphatics draining the diseased area are enlarged and soft in acute processes and harder in chronic processes from exerting their protective function against acute general involvement by absorption. Lymphatic glands are always located at the neck of an organ in movable tissues adjacent to the vascular supply. There are two or three glands on the cystic duct and several along the hepatic and common ducts, the latter drain the head of the pancreas and the duodenum. Inflammation of the pancreas, however, usually involves also the gall-bladder or ducts. Ulceration of the duodenum may cause swelling of these glands. If the symptoms of gall-bladder disease indicate exploration and upon examination there are no gall-stones and but little change in the appearance of the gall-bladder, these glands should be palpated. Given sufficient symptoms for surgical intervention, if these glands are swollen without other adequate cause as from diseased duodenum, pancreas or general abdominal infection the gall-bladder should be removed whether or not stones are present. On the other hand, given such symptoms, if no gall-stones are found and if the glands are not swollen, then some other cause for the symptoms must be searched for, since the patient probably will not be relieved by an operation on the gall-bladder.

What causes inflammation of the gall-bladder? There are several theories. First, that of an ascending infection from the duodenum by way of the ducts, second, infection by way of the lymphatics, and third, infection by the portal route through the liver which fails to destroy the bacteria brought to it. The first theory, that is, ascending infection, has not been generally accepted. The second, that is lymph stasis, has been accepted with considerable reservation for some conditions. The third, that is, living bacteria in the bile which have passed through the liver, has been more generally accepted. The first and last theory, however, acknowledge that living bacteria in the bile penetrate a living healthy mucosa lining the gall-bladder which is made for, and should be able to, protect itself against such conditions. To believe this we must consider the surface of the mucosa as the vulnerable point, which is possible but less probable than that the attack is commonly in the unprotected rear, that it is by way of the blood stream.

The vascular route as suggested by Rosenow looks very plausible. We have long accepted the fact that the well-known infectious diseases have each a specific bacterium which causes, according to the type, a definite group of symptoms in lungs, intestines, skin, mucous membranes, tonsils or elsewhere. To Rosenow is the credit due for the theory that the bacteria which cause similar acute and chronic diseases,

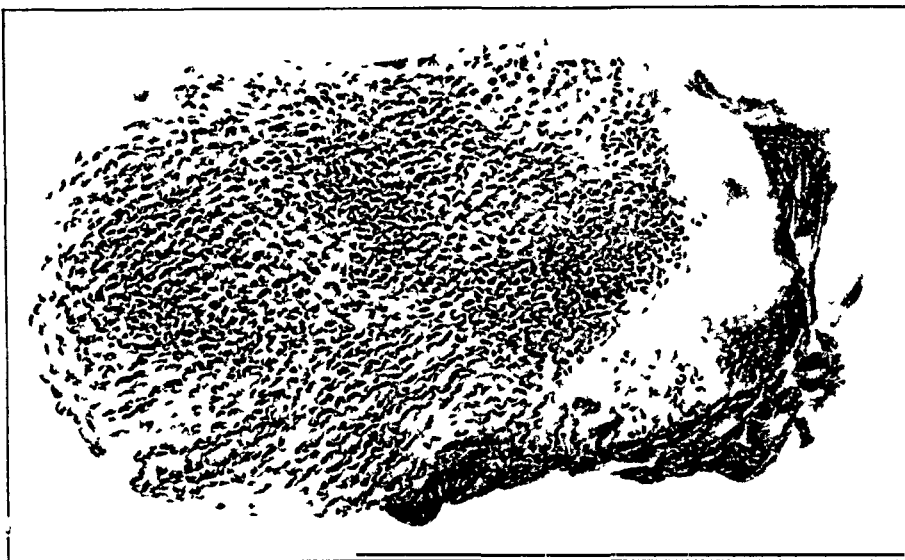


FIG 1 —132852 Strawberry gall-bladder

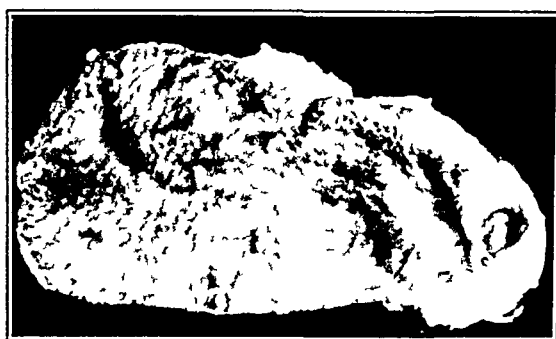


FIG 2 —A106500 Papillomata

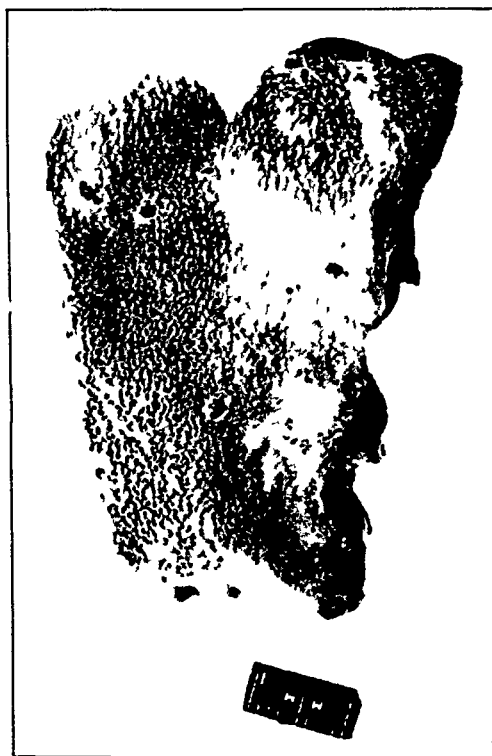


FIG 3 —A78954 Papillomata and strawberry gall-bladder



FIG 4 —96944 Chronicolecysitis strawberry gall-bladder with papillomata



## PAPILLOMAS OF THE GALL-BLADDER

such as cholecystitis, have the same definite function, and that when they enter the blood stream they search out locations with the same environment as that in which they originated. He has shown that changes in environment can change bacteria in appearance, and in the effects caused by them, and in their tendency to locate in vascular or mucous surfaces, or to cause inflammation of the joints. Such bacteria are cultured in a certain focus in the body and thence through the vascular system, producing a varying degree of infection in a gall-bladder, while bacteria cultivated from acute gall-bladder inflammation entering the vascular system may produce similar acute gall-bladder inflammation in another individual. In certain investigations, some of which were made at our Clinic, Rosenow has shown that bacteria cultivated from the tissues of the gall-bladder and those from the glands along the ducts showed similar growth, further, that such cultures of bacteria injected into dogs caused similar changes in their gall-bladders. Such a result occurred approximately in two-thirds of the experiments. Not alone, however, is the gall-bladder affected. Some experimental animals show associated rheumatism and some heart, kidney or other involvement due to bacterial changes from new environment.

Cholecystitis then is a disease of the gall-bladder caused by bacterial invasion of the wall of the structure. In this direct manner do we have changes in its circulation with œdema, infiltration, exudation, swelling of the lymphatic glands and local necrosis of the mucous membrane, for example, strawberry gall-bladder. This infiltration of the gall-bladder structure with cells and bacteria prevents the distention and contraction of the sac and causes pain. Thus may be caused qualitative food dyspepsia and symptoms of epigastric gas pressure.

Papillomas of the gall-bladder occur in the same manner, but instead of a primary destructive effect, there occurs locally a hyperplasia or overgrowth which later may become necrotic. That the disease is more common than is ordinarily supposed is indicated by the fact that it was found 107 times in 2538 cases of cholecystectomy made at our Clinic from January 1, 1907, to June 1, 1915. The glands above described were enlarged in these cases. The pathology of these cases has recently been studied by MacCarty and Irwin, who summarize the results of their observations as follows:

“The diseases of the gall-bladder have been classified as follows  
1 Acute catarrhal cholecystitis 2 Chronic catarrhal cholecystitis 3 Papillomatous catarrhal cholecystitis 4 Malignant papillomatous cholecystitis 5 Carcinomatous catarrhal cholecystitis 6 Chronic cholecystitis 7 Chronic cystic cholecystitis 8 Purulent necrotic cholecystitis”



"Of these, groups 3 and 4 have been the subject of the present study. In all the cases in group 3 (Figs 2-4), papillomatous catarrhal cholecystitis, the mucosa is intact. The papillomas vary from twice to five or six times the length of normal villi. They are usually pedunculated, frequently racemose and usually white or yellow. They appear in any portion of the organ, being confined neither to the neck nor the fundus. Upon microscopic section, they appear to be hypertrophic villi, the tissue elements of which present a hyperplastic condition. The connective tissue and glandular tissue are greatly increased, the latter being so distorted that sections cut the glands in many different planes. The epithelium of the glands is hypertrophic and occasionally hyperplastic and practically always completely covers the growth. In the stroma one often finds large round or oval cells which contain fat or some fatty substance, this condition probably being responsible for the yellowish gross appearance of the growths."

"In no case are there any early signs of carcinoma, although similar hypertrophic conditions of the villi have been seen in association with carcinomatous outgrowths of the gall-bladder. The condition occurs in acute catarrhal cholecystitis, chronic catarrhal cholecystitis, cystic catarrhal cholecystitis, carcinomatous catarrhal cholecystitis and purulent necrotic catarrhal cholecystitis. It occurs with and without the association of stones, and is more frequent in females than in males, probably due to the fact that more gall-bladders are removed from females."

"Papillomas are but an associate pathologic condition found in cholecystitis. One theory of origin is that they possibly originate in surface cracks through overdilatation, caused by mucous obstruction and swelling of the mucosa incident to cholecystitis associated with the presence of bacteria or irritants from stagnation of gall-bladder contents. It is, however, not so plausible as Rosenow's theory of vascular-borne infection of the gall-bladder mucosa."

"Like papillomas in other portions of the body, those in the gall-bladder undergo an irregular or perverted epithelial hyperplasia which manifests itself in marked reduplication of the rows of epithelial cells. This condition constitutes malignant papillomatous cholecystitis. Differentiation between this condition and carcinomatous catarrhal cholecystitis must be made with reserve because it is possible that the one is but a stage of the other."

From the surgical standpoint, it is important to note that the papillomas of the gall-bladder are not cured by temporary drainage but that cholecystectomy should be performed.

# A REPORT OF THE CASES OF GALL-STONE DISEASE OPERATED DURING THE YEAR 1914 \*

BY JOHN B. DEEVER, M.D.  
OF PHILADELPHIA

IN reviewing the case records of gall-stone disease operated in my clinic at the German Hospital during the year 1914, and in comparing the pathological findings at the operating table with the *subjective* symptoms presented by the patients, and the operative procedures with the ultimate relief afforded, my attention was drawn to a few salient points which are here presented in a more or less statistical form

The cases presented number 159, 87 of which are classified as simple gall-bladder disease, including types of cholecystitis with or without stones, 20 cases of gall-bladder and common duct involvement, 52 cases of gall-bladder disease with secondary pancreatic involvement, and 7 re-operative cases

The average age of patients at the time of operation was forty-four years, in simple gall-bladder disease forty-five years, and in those cases with involvement of the common duct, or of the liver and pancreas, forty-seven and forty-one years, respectively. The age of the pancreatic cases was lower at operation, owing to the greater severity of symptoms which drove these patients to seek operative relief at an earlier date

The decade of life showing the greatest frequency in all cases was between forty and fifty years, averaging 36.8 per cent in the uncomplicated cases, 40 per cent in the common duct cases and 46.4 per cent in the pancreatic cases. The next period of greatest frequency was between thirty and forty, averaging 24 per cent, 15 per cent and 33 per cent respectively. Simple gall-bladder disease shows a higher percentage below forty years than those with secondary involvement, and above fifty and below thirty the frequency diminishes rapidly, this trend being even more marked in the common duct cases. It is to be noted that though the incidence of frequency increases progressively up to the age of fifty, it does not correctly represent either the beginning of the acute process or the time of formation of the stones. Doubtless many start in early life and remain relatively dormant, except for a few vague premonitory symptoms which are diagnosed and

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\* Read by title before The American Surgical Association, June, 1915

treated as gastritis, indigestion and dyspepsia. The many acute infectious diseases which occur during early adult life may start the process in the gall-bladder and, as middle age approaches with its more sedentary habits and resultant stagnation of bile flow, result in definite gall-bladder lesions.

Gall-bladder disease is more frequent in women than in men, in the simple cases 85 per cent were females, or, as Schroeder has shown, five times more frequent, in the other two groups 60 and 70 per cent respectively were females with a diminishing ratio of 22 to 1.

The largest number of males is found in the group characterized by pancreatic involvement, a fact which agrees with previous studies of pancreatitis by Pfeiffer and myself, which showed the greater liability of males to pancreatic disease.

Stagnation of bile flow and infection, which are respectively the predisposing and exciting causes of biliary disease and stone formation, find their greatest opportunity in the female sex. The natural sedentary habits of the female, poor muscle tone, ptosis of the abdominal organs, especially the liver, causing kinking of the extrahepatic ducts and the many pelvic infections, account for the great frequency in this sex.

An analysis was made also of the female cases before and after forty-five, the accepted age of menopause. It is well known that common duct cholelithiasis is merely the result of the wandering of stones from the gall-bladder when they are forced through the cystic into the common duct. It is but natural, therefore, that common duct involvement, representing, as it does, a later stage of the same disease, should show a later age incidence as noted in this series, common duct cases were more numerous after the menopause. Uncomplicated gall-bladder disease, as well as that associated with pancreatitis, was most numerous before that period.

The duration of symptoms before operation was eleven months in all cases, but in simple gall-bladder disease and in the pancreatic cases the time intervening was over three years. In the common duct group 30 per cent were of one to five months' duration.

The diagnosis of gall-bladder disease is not always a simple one, owing to the many structures in close proximity to it and the resultant complications which follow infection in this region, but the most consistent symptom has been a long-continued history of indigestion and flatulency with recurrent attacks of pain in the epigastrium and upper right abdominal quadrant. This pain is a constant symptom, not always of the sharp colicky character so typical of the movement of a

foreign body passing from a larger tube to a smaller one, but dull, constant or intermittent discomfort in the gall-bladder region. Of all the cases in this series 94 per cent had pain which was most constant in the upper right abdominal quadrant, in the simple cases 64 per cent had pain in this region, but the majority of the pancreatic cases had pain primarily in the epigastrium.

Sharp colicky pain may also be due to infection of the regional peritoneum with subsequent adhesions. Sixty-one per cent of the simple and pancreatic cases had this character of pain and in these cases at operation many pericholecystic adhesions were found.

Riedel has laid stress on the fact that sharp colicky pain in gall-stone disease is not always due to stone, and gives the following causes of *colicky pain in gall-stone disease*

- 1 Adhesions of gall-bladder without stone
- 2 Adhesions with large stones in the gall-bladder and the cystic duct patent
- 3 An inflamed distended gall-bladder containing stones with an occluded cystic duct or a stone in the neck of the gall-bladder
- 4 Inflammation of the common duct
- 5 Transit of a stone through the extrahepatic ducts

To this should be added the biliary obstruction which sometimes accompanies exacerbations of pancreatic inflammation.

Referred pain was a fairly constant symptom, found most often in the right shoulder and right costal border. Some cases had referred pain to the right iliac fossa, but in these cases a chronically diseased appendix was found. Occasionally pain will be referred to the left hypochondrium or back, and in these cases secondary adhesions of the duodenum or stomach are commonly found.

The duration of pain was analogous to the duration of symptoms in most cases, extending over a period of three years in all cases.

The period intervening since the last attack was short, being one week in 30 per cent of cases.

Tenderness and rigidity were also present, especially during or shortly after an attack of acute pain, but even in the more chronic cases as a rule deep palpation under the costal border elicited some tenderness and resistance to the palpating hand.

Vomiting after meals was most often present in simple gall-bladders, but indigestion, flatulency and nausea were found most frequently in common duct cases. Constipation was a variable symptom found in most cases but most common in pancreatic lesions.

The fact that jaundice is not always due to demonstrable obstruction

of the ducts was shown clearly in these cases. Jaundice was found in all groups. In simple gall-bladder disease it was present in 41 per cent, in common duct cases in 55 per cent, and in pancreatic involvement in 38 per cent. There are many causes of jaundice other than stone obstruction. In general it may be said that the chief cause of jaundice other than actual mechanical obstruction, which is surgically removable, is infection which may act either on the extrahepatic ducts, causing swelling, and in that way occluding the ducts of discharge, or the infection may ascend into the finer radicles of the bile ducts, causing what has been termed a cholangitis, and in this manner give rise to intrahepatic obstruction and the discharge of bile into the lymph and blood streams.

Not much help is derived from laboratory and X-ray findings. That the X-ray can show gall-stones in a percentage of cases there is no doubt, but that this is fortunate I am not prepared to say. Too much confidence placed in X-ray diagnosis will influence the patient, I fear, and perhaps the doctor as well, to procrastinate. In the absence of positive findings this would be most unfortunate, as we know that gall-stone disease advances and does harm through infection and not merely as the result of gall-stones themselves.

The blood showed slight diminution of hæmoglobin and erythrocytes in common duct cases, and the leucocytes on an average were fairly constant. Not much reliance can be placed in coagulation time, as the present methods of determining it are very inadequate and unscientific. In simple gall-bladder cases the average was 4.6 minutes. The longest in the pancreatic cases was 14 minutes.

From the examinations of the stools and test-meals we derived very little benefit in making a diagnosis. Most stools showed bile and a majority showed occult blood to the benzidin test, while 9 cases were positive to the guaiac test for occult blood. The test-meals for free and total hydrochloric acid averaged 16 free HCl and 40 total acidity.

*Operations and Operative Findings*—The mortality in the entire series was 6.3 per cent, being distributed as follows: in uncomplicated gall-bladder disease 4.5 per cent, in common duct cases 5 per cent, and in gall-bladder disease plus pancreatic involvement 9 per cent. The total number of deaths was 10. In 2 cases carcinoma was present, involving the gall-bladder in one case and the pancreas in the other. Two perished from uncontrollable hæmorrhage, the sequel of chronic cholæmia which I have found no means to control. Two cases died of cardiac insufficiency. One died of obstruction two months after operation, one of peritonitis, one of pneumonia and another died on the table.

of respiratory failure following the use of intraspinal stovaine. Over half of these deaths can justly be attributed to delay as much as to the operative procedure. Carcinoma, it seems probable, is in some way associated with the chronic irritation of long-existing infective processes. Myocarditis is, as Babcock has so well pointed out, a direct result of the toxæmia of upper abdominal infection. Chronic cholæmia to the degree of robbing the blood of its coagulation properties is an arraignment of the management of the case.

The type of operation was determined by the pathology found. In general the indications for cholecystectomy were extended as compared with my former practice. Thickened, functionless gall-bladders and those showing a condition of empyema, mucocele, or imbedded stones were sacrificed without hesitation. In addition to these a large group of obviously infected gall-bladders, with or without stones, but complicated by pancreatitis or peripancreatic lymphangitis, were treated by cholecystectomy. The reason for this is partly to be found in the demonstration by Rosenow that the gall-bladder wall in these cases harbors virulent bacteria, partly in the fact that the extension of the inflammation which was being transmitted to neighboring structures constituted too gross a menace to assume risk of further trouble, and finally in the desire to avoid a percentage of recurrences after simple drainage of the gall-bladder, which it has been my lot to observe.

Almost without exception when the gall-bladder was removed a choledochostomy was made and drainage accomplished by means of the T-tube. Drainage I regard as the most essential part of operations upon the biliary tract. It should be prolonged rather than short. I have under observation a case referred by my colleague, Dr. Riesman, in which the patient has been carrying a T-tube in the common duct for over two years. She refuses to allow it to be removed, having experienced on two former occasions a recurrence of symptoms after removal of the tube. This is exceptional, but it shows how well the tube is tolerated and how efficacious it is in relieving back pressure upon the liver in cases of blockage by enlarged pancreas, strictured duct or other cause of obstruction.

It is not easy in borderline cases to determine whether to remove the gall-bladder or leave it. When pronounced disease is present I feel that the best ultimate result will be obtained by removal if the case is in skilled hands. The operative mortality should not be materially increased over that of cholecystostomy in the same group of cases.

A cholecystectomy alone or associated with other operations, as

appendectomy, choledochostomy, gastrojejunostomy, was done in 115 cases with a mortality of 52 per cent

The mortality in cholecystectomy at present is higher for several reasons. It is done chiefly in those cases which have marked pathological lesions that have rendered useless the gall-bladder, or in septic cases with an empyema or gangrenous gall-bladder, so aside from the severity of an operation which extirpates rather than opens, the operative risk is greater, due to the pathological conditions which necessitate it. Cases requiring cholecystectomy, aside from acute conditions, are more often older and seriously damaged organically by long standing disease.

In 40 cases of cholecystostomy there was one death.

Most cases showed adhesions at operation. In the simple gall-bladder group 24 cases had adhesions between the gall-bladder, duodenum and stomach, and 14 cases between the gall-bladder and great omentum. In this series 44 per cent had adhesions, of which over half were between the gall-bladder, stomach and duodenum. In the common duct group 65 per cent had adhesions, 46 per cent of which were between the gall-bladder and omentum, and in the pancreatic group 34 per cent had adhesions, three-fourths of which were about the gall-bladder, including stomach, duodenum, or hepatic flexure with the gall-bladder and liver.

Stones were found at operation in 70 per cent of all cases. As mentioned above, we may have severe gall-bladder disease with jaundice and toxæmia without stones.

In those cases showing marked infection of the common duct with pus formation, symptoms of cholangitis were present—the infective organisms spreading up the hepatic ducts into the finer radicles of the liver, producing there enlargement and marked toxic symptoms. These cases are bad surgical risks. Death in these cases is due to cessation of liver function, and exhaustion and hemorrhage from blood changes. Operation is fraught with a high immediate mortality and delay is equally dangerous, as pus under pressure must be evacuated. The only safe procedure is a preventive one of removing the disease while it is yet in the gall-bladder.

The cultures taken from the bile and pus showed *Bacilli coli communis* most frequently.

The most common accompanying lesion was in the appendix, which was removed in 80 cases. Most of these showed chronic interstitial and obliterative appendicitis. There is a marked relation between chronic appendicitis and gall-stone disease, and in this series 80 cases gave symptoms of a long-continued discomfort in the appendiceal region.

The pathological findings of gall-bladders removed showed a preponderance of chronic interstitial cholecystitis in all groups with acute exacerbations of the same lesion next in frequency

In this series I encountered six cases who had had previous operations for gall-bladder disease, for failure of which the present operations were performed. In four of these cases a cholecystostomy was done at the primary operation, and in two cholecystectomy had been done. The recurrence of symptoms in the cholecystectomy cases were due to pancreatic disease and improved on drainage of the common duct. Reoperations in the cholecystostomy cases were due to persistent fistula, or recurrence of symptoms, the latter being caused by reinfection, the reformation of stones or possibly by stones undiscovered at the primary operation.

In two cases cholecystectomy and choledochostomy were made, and in two cholecystoduodenostomy was indicated by pancreatic obstruction. All have recovered with marked immediate improvement.

### CONCLUSIONS

1 Gall-bladder disease is preeminently a disease of the middle-aged female, but is by no means confined to that age or sex.

2 The early diagnosis can be made only by familiarity with a different symptomatology than that found in our text-books. The lighter grades of dyspepsia with localizing signs, however slight, in the epigastrium or right hypochondrium must be regarded as very suspicious of the beginnings of the gall-stone disease.

3 Gall-stones are merely the terminal stage and by no means the uniform accompaniment or most dangerous factor involved in gall-stone disease.

4 Infection as the cause, not only of gall-stones, but of the local and systemic damage of the disease, is the essential thing to recognize and treat.

5 The X-ray in diagnosis is dangerous therefore, not only because it fails to show a large percentage of stones, but because it emphasizes the importance of the calculous element of the disease, and if allowed to serve as an indication for operation will deprive many of the early treatment which alone is safe and efficacious.

6 Cholecystectomy is the operation of choice in obviously diseased gall-bladders, with drainage of the common duct in practically all cases, but particularly in those giving evidence of cholangitis or pancreatic involvement.



# JOHN B DEAVER

## GALL-BLADDER STATISTICS

Simple gall-bladder disease	87 cases
Gall-bladder and common duct	20 cases
Gall-bladder and pancreas	52 cases

### AGE AT OPERATION

	Average	Oldest	Youngest
Gall-bladder disease	45	70	20
Gall-bladder and common duct	47	75	19
Gall-bladder and pancreas	42	63	21

### SIMPLE GALL-BLADDER DISEASE

	Case	Per cent
Under 20 years	1	1.14
20 to 30 years	9	10.3
31 to 40 years	21	24.1
41 to 50 years	32	36.8
51 to 60 years	15	17.2
61 to 70 years	7	8
71 and over	2	2.2

### GALL-BLADDER AND COMMON DUCT

	Case	Per cent
Under 20 years	1	5
21 to 30 years	1	5
31 to 40 years	3	15
41 to 50 years	8	40
51 to 60 years	3	15
61 to 70 years	3	15
70 and over	1	5

### GALL-BLADDER AND PANCREAS

	Case	Per cent
Under 20 years	0	00
21 to 30 years	4	7.5
31 to 40 years	17	33
41 to 50 years	24	46.1
51 to 60 years	6	11.5
61 to 70 years	1	1.9
70 and over	0	00

### SIMPLE GALL-BLADDER DISEASE

Males, 13 (average age 47)	14.9 per cent
Females, 74 (average age 44.3)	85.1 per cent

### GALL-BLADDER AND COMMON DUCT

Males, 8 (average age 44.8)	40 per cent
Females, 12 (average age 49.2)	60 per cent

### GALL-BLADDER AND PANCREAS

Males, 16 (average age 39)	30 per cent
Females, 36 (average age 39)	70 per cent

# CASES OF GALL-STONE DISEASE

## FEMALES BEYOND FORTY-FIVE, OR ACCEPTED AGE OF MENOPAUSE

### SIMPLE GALL-BLADDER DISEASE

Above 45 years of age	34	45.9 per cent
Under 45 years of age	40	54.1 per cent

### GALL-BLADDER AND COMMON DUCT

Above 45 years of age	11	55 per cent
Under 45 years of age	9	45 per cent

### GALL-BLADDER, PANCREATIC INVOLVEMENT

Above 45 years of age	15	41.6 per cent
Under 45 years of age	21	58.4 per cent

## OPERATED CASES

### SIMPLE GALL-BLADDER DISEASE

Recovered	83	95.5 per cent
Died	4	4.5 per cent
1 Post-operative pneumonia, peritonitis		2 weeks after operation
2 Carcinoma gall-bladder		2 days after operation
3 Cardiac dilatation		1 day after operation
4 Peritonitis		5 days after operation

### GALL-BLADDER AND COMMON DUCT

Recovered	19	95 per cent
Died	1	5 per cent
Hemorrhage		13 days after operation

### GALL-BLADDER AND PANCREAS

Recovered	45	85.5 per cent
Improved	2	5.0 per cent
Died	5	9.5 per cent
1 Partial obstruction		2 months after operation
2 Hemorrhage		9 days after operation
3 Heart failure		9 days after operation
4 Failure respiratory centre, stovaine		on table
5 Carcinoma, pancreas		few hours

## CHOLECYSTECTOMY

Simple gall-bladder disease	
Cholecystectomy alone or combined with other operations	64 cases
With 3 deaths, 4 per cent	
Gall-bladder and common duct	
Cholecystectomy alone or combined with other operations	18 cases
No deaths	
Gall-bladder and pancreas	
Cholecystectomy alone or combined with other operations	14 cases
With 2 deaths, 3 per cent	
Gall-bladder, common duct and pancreas	
Cholecystectomy with other operations	19 cases
With 1 death, 1.3 per cent	

# JOHN B DEAVER

## SIMPLE GALL-BLADDER DISEASE

	Cases	Deaths
Cholecystectomy	19	2
Cholecystectomy, appendectomy	43	1
Cholecystectomy, gastrojejunostomy	1	
Cholecystectomy, ileocolostomy	1	
Cholecystostomy	14	1
Cholecystostomy, appendectomy	14	

## GALL-BLADDER AND COMMON DUCT

	Cases	Deaths
Cholecystectomy, choledochostomy	18	
Choledochostomy alone	1	1
Cholecystoduodenostomy	1	

## GALL-BLADDER AND PANCREAS

	Cases
Cholecystectomy and appendectomy	8
Cholecystectomy	6
Cholecystostomy and appendectomy	6
Cholecystostomy	5

## OTHER OPERATIONS AT SAME TIME

Simple gall-bladder	Gall bladder and common duct	Gall-bladder and pancreas
Appendectomy 45	Appendectomy 10	Appendectomy 25
Oophorectomy 3	Umbilical hernia 1	Tubes and ovary 2
Myo nectomy 2		Right Inguinal hernia 1
Ileocolostomy 1		Pancreas drained 1
Salpingectomy 2		Incisional hernia 1
Hernia 1		

## ADHESIONS AT OPERATION

### SIMPLE GALL-BLADDER DISEASE

	Cases
Omentum and liver	21
Duodenum and stomach	27
Hepatic flexure	4

Forty-four per cent showed adhesions with 61 per cent to stomach and duodenum

### GALL-BLADDER AND COMMON DUCT

	Cases
Gall-bladder, stomach, duodenum, liver	4
Omentum and gall-bladder	6
Liver and duodenum	1
Gastrohepatic omentum and liver	2

Sixty-five showed pericholecystic adhesions, 46 per cent between gall-bladder and great omentum

# CASES OF GALL-STONE DISEASE

## GALL-BLADDER AND PANCREAS

	Cases
Stomach and duodenum	12
Omentum	11
Liver and duodenum	8
Hepatic flexure	1
Around pancreas	3
Thirty-four per cent showed adhesions of stomach and duodenum	

## LABORATORY REPORTS

	Simple gall-bladder	Gall-bladder and common duct	Gall-bladder and pancreas
Hæmoglobin average	82.8	79	81.6
Red blood-cells average	4,593,820	4,850,000	2,665,416
White blood-cells average	9,035	9,145	9,480
Polymorphonuclears	68.9	75.2	70
Coagulation time	13 min	7.5 min	9.8 min.
Low	1.5 min	3 min	1
High	4.6 min	13 min	14

## STOMACH CONTENTS

	Simple gall-bladder			Gall-bladder and common duct			Gall-bladder and pancreas		
	Average	Low	High	Average	Low	High	Average	Low	High
Free HCl	16	0	67	16	0	80	16	0	51
Total HCl.	41	0	102	39	4	150	41	16	103

## PATHOLOGICAL DIAGNOSIS

### SIMPLE GALL-BLADDER

Chronic interstitial cholecystitis	46 cases	65 per cent
Chronic suppurative	4 cases	
Gangrenous	7 cases	
Acute interstitial	2 cases	
Chronic catarrhal	3 cases	
Adenocarcinoma gall-bladder	2 cases	

### GALL-BLADDER AND COMMON DUCT

Chronic interstitial cholecystitis	13 cases
Chronic catarrhal	1 case
Acute interstitial	2 cases
Gangrenous	1 case

### GALL-BLADDER AND PANCREAS

Chronic interstitial cholecystitis	20 cases
Chronic Catarrhal	4 cases
Suppurative	1 case

# FISTULOUS COMMUNICATION BETWEEN THE STOMACH AND COLON, FOLLOWING GASTRO-ENTEROSTOMY \*

BY CARL A. HAMANN, M.D.

OF CLEVELAND, O.

DR. C. aged sixty years had for many years a duodenal ulcer, as shown by all the characteristic symptoms and signs. At the operation on December 19, 1910, a large callous ulcer involving the first part of the duodenum was found. A posterior, "no-loop" gastro-enterostomy was done, followed by recovery of health for a period of several months. Then he began to have hæmatemesis and bloody stools again.

On May 15, 1911, five months after the first operation, the ulcerated part of the duodenum with a small part of the stomach was excised.

He then enjoyed pretty good health for about two and one-half years when, after a severe straining effort in running his automobile, he had severe pain followed by intestinal hemorrhage. After this he continued to suffer, the main symptoms being loss in weight and strength, diarrhoea, loss of appetite and a fecal odor from gastric eructations, there was also considerable visible peristalsis.

An X-ray examination after the ingestion of a bismuth meal showed a rather confused picture which we could not clearly interpret.

On account of the patient's condition, extended X-ray observations were not considered advisable, but the following facts were obtained:

"The bismuth-meal passed rapidly from the stomach through the gastro-enterostomy opening into an enormously distended jejunum, and into the blind end of the duodenum which was likewise distended to almost three inches in diameter. From this location the path of the bismuth-meal could not be accurately determined on account of the marked distention of portions of the small bowel. However, part of the bismuth could be seen disseminated in these coils. A careful study of the radiographs made in the light of the operative findings showed that a small amount of bismuth had entered directly from the jejunum into the colon. The distended condition of the small bowel indicated that there

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\* Read before the American Surgical Association, June 10, 1915.

## STOMACH-COLON FISTULA

had been a marked degree of intestinal obstruction" (Dr Geo F Thomas)

On December 31, 1914, he was operated upon for the third time. There was found considerable thickening about the gastro-enterostomy opening, and the transverse colon was adherent to the stomach and jejunum. A finger could be passed from the stomach into the small intestine and also into the colon, there was some dilatation of the jejunum on the distal side of the anastomosis, and also of the colon on the proximal side of the gastrocolic fistula. There was no ulcer.

The adherent viscera were separated from one another, the gastric and jejunal openings were closed and about four inches of the transverse colon were resected, as the gut was much contracted at the point of adhesion to the stomach, the operation was completed by making an anterior gastrojejunostomy.

On the fifth day after the operation he passed considerable blood per anum, and later on it became necessary to resuture the abdominal wall. Complete recovery occurred and, at present, six months after his last operation, he is enjoying good health.

To summarize the main facts in connection with the above case: Posterior gastro-enterostomy, for duodenal ulcer, followed in five months by partial resection of stomach and duodenum, necessitated by recurring hemorrhage, a period of good health for two and one-half years, then, after a severe strain, another hemorrhage, which was followed by a period of several months of ill-health, characterized by loss in weight and strength, diarrhoea, and by eructations from the stomach which had a fecal odor. A third operation at which there was found a gastrocolic fistula. Separation of stomach, jejunum and colon from one another, closure of the openings in stomach and jejunum, resection of part of transverse colon and the making of a new (anterior) gastro-enterostomy. Recovery with restoration of health.

The formation of the gastrocolic fistula was due, no doubt, to a gastrojejunal ulcer, following gastro-enterostomy, around which adhesions formed between the stomach and colon and later a fistulous communication between the stomach and colon was gradually established.

According to Voorhoeve<sup>1</sup> the first case of gastrocolic fistula was described by Haller in 1755, Hilgenreiner<sup>2</sup> stated in 1912 that the number of recorded cases was 119.

The cause of these fistulae is nearly always some gastric affection, such as carcinoma or ulcer, which, secondarily, after adhesions to the colon have formed, results in perforation of the walls of the large intestine. Since the introduction of the operation of gastro-enterostomy,

there has been added another factor, namely gastrojejunal, or peptic ulcer of the jejunum, which may, by perforating into the colon, produce the lesion under discussion. There is thus found, in some cases at least, what may be described as an indirect fistula between the stomach and colon, the peptic ulcer of the jejunum perforating into the colon in close proximity to the gastro-enterostomy opening. However, the disturbance produced and the symptoms of such a gastrojejunocolic fistula are practically the same as those of a gastrocolic fistula.

Patterson in 1909 collected 114 cases of peptic ulcers of the jejunum, following gastro-enterostomy, 5 of these perforated into the colon. Hilgenreiner (*loc cit*) in 1912 added 8 more from the literature.

The chief symptoms of gastrocolic fistula are three in number, viz fecal vomiting or eructations of foul-smelling (fecal odor) gases, without other signs of intestinal obstruction, diarrhoea, or henteric discharges, and loss in weight. That these symptoms should occur is obvious and their explanation is equally plain. Other evidences of the condition are the ability to inflate the stomach from the rectum, the vomiting of enemas, the withdrawal by gastric lavage of colored fluid introduced into the rectum, and the finding of pepsin and hydrochloric acid in the faeces. None of these symptoms are, however, constantly found.

The size and position of the opening, its possible valve-like character, the condition of the pylorus and other factors may cause variations in the symptoms in different cases. It has been pointed out, for instance, that in case of pyloric stenosis, if a gastrocolic fistula forms, the former vomiting may cease, as the gastric contents then pass into the colon, also if the position and size of the fistula are such that the food cannot readily enter the colon, the stomach will remain filled for a time and faeces cannot enter it, in case of a large opening, fecal vomiting may be absent because the food more readily enters the colon, and, *vice versa*, the fistula may be too small to allow faeces to enter the stomach.

In recent years, X-ray examination has afforded aid in the diagnosis. Voorhoeve (*loc cit*), Neumann,<sup>3</sup> Haudek<sup>4</sup> and others have described the radiographic findings.

After a bismuth meal the ingested material may be seen to enter the colon directly, the stomach not filling up as normally is the case, the rapid filling of the descending colon and sigmoid is also to be observed. It may be possible to force the material from the stomach into the colon, and *vice versa*, by external pressure, the simultaneous presence of bismuth in the small intestine and the distal parts of the colon, the proximal

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portions of the colon being free or nearly so from bismuth, may be observed

Upon injecting bismuth into the rectum, it passes into the stomach or by external pressure it may be forced there. Bismuth may be found in the small intestine, after a rectal injection, showing that it has entered from the stomach, for normally, when a rectal injection is made it does not pass beyond the ileocæcal valve. The increase in size of the *Magenblase* may also be observed when air is forced into the rectum (Voorhoeve)

When there is a gastrojejunocolic fistula, as is perhaps usually the case when gastro-enterostomy has been done and a gastrojejunal ulcer is the cause of fistulous communication with the colon, the X-ray picture is rather confusing and hard to interpret, as in my case

The treatment of gastrocolic and gastrojejunocolic fistulæ naturally consists in separating the adherent viscera from one another, and closing the openings in each, resections and entero-anastomosis or other procedures may become necessary, depending upon the peculiarities of the individual case

Hilgenremer (*loc cit*) has collected 11 cases in which operation was done, two of which were fatal

## REFERENCES

- <sup>1</sup> Deutsches Arch f klin Med, Bd 106, 1912, p 294
- <sup>2</sup> Centralbl f die Grenzgeb der Med u Chir, Bd 45, 1912, p 364
- <sup>3</sup> Fortschritte auf dem Gebiete der Roentgenstrahlen, Bd 22, 1913, p 398
- <sup>4</sup> Wiener med Wochenschr, Bd 62, 1912, p 3104



# PAGET'S DISEASE OF THE NIPPLE AND ALLIED CONDITIONS \*

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PAGET'S disease of the nipple, as it is commonly designated, derives its name from the brief contribution in *Saint Bartholomew's Hospital Reports*, vol. x, 1874, by Sir James Paget, under the title of "Disease of the Mammary Areola Preceding Cancer of the Mammary Gland." Since that time it has received a number of other names, usually framed by their originators to indicate its true pathological nature, or what they supposed this to be, but so far without displacing this as the common title under which it is indexed and described. To Paget belongs the credit for bringing it to the attention of the profession in the clear, concise description of the appearance and clinical course of the malady, a description which, in its essential features, is difficult to improve upon, although later studies have enabled us to contribute much to our knowledge of the variations and modifications which location and time of observation may make in its clinical course and macroscopic appearance, while an apparently unending stream of contributions on the histo-pathology of the disease has flowed through the literature from that time down to the present day. Indeed, it would seem to have engrossed, in view of its rarity, an amount of time in the minds of dermatologists, pathologists and surgeons out of all proportion to its importance, the reasons for which we will return to later.

While credit is usually given to Paget for the first description and while the judgment of time has continued to designate it by his name, yet, as Wiggan and Fordyce point out, the disease had been described many years before by Velpeau. We have copied from the *Leçons Orales de Clinique Chirurgicale*, in the section on Diseases of the Female Breast, the following paragraph

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## PAGET'S DISEASE OF THE NIPPLE

Degenerescences Croûteuses—Le mamelon se couvre quelquefois d'une affection squammeuse, tenant le milieu entre l'eczema chronique et la psoriasis. Je l'ai observée deux fois chez dames qui avaient depuis long temps cesse d'allaiter. Les croûtes qui recouvraient l'organe étaient d'un gris verdâtre dans un cas, d'un gris jaunâtre dans l'autre, assez épaisses, fendillées et adhérentes. D'es qu'on cherchait à les détacher, on voyait survenir sur les petites plaies un suintement sanguin assez abondant.

He adds that the affection is often accompanied by an itching that is almost insupportable, that compels the bearer to scratch and affects the general health. It lacks the ordinary signs of inflammation. Velpeau traces its source to irritation of the nipple by rubbing against the underwear or the corset, and says that while it is frequently cured by the use of a white precipitate ointment, as in one of his cases, it may sometimes, when of long standing, resist any treatment short of amputation of the nipple, which was the outcome in the other case. We have quoted Velpeau's description and views of what were apparently cases of the lesion under discussion because we have encountered the barest mention of his name in connection with the subject.

Paget's article was based upon 15 cases personally observed by him and, since that time, there have been reported in the neighborhood of 140 cases, not a large number for 40 years when one considers the frequency of breast lesions and of dermatological affections in general. By no means all of these cases were operated upon and many of the important contributions to the pathology of the subject and many of the theories as to its origin and true nature, including its relationship to breast cancer, have been founded upon the study of two or three cases, and these studies sometimes with and sometimes without a careful analysis of previous contributions, and a consideration and weighing of the work done by eminent and skilled investigators on the same subject. In the meantime, and since it was first described by Paget, the pendulum of opinion as to the primary or secondary nature of the disease has swung back and forth, and theories have been formulated, and forgotten, and revived without arriving at any unanimity of opinion, until the present time, when the unprejudiced observer will find that dermatologists and surgeons, including in the latter group surgical pathologists, are arrayed on opposite sides of the main question, and that there exist in each group minor differences of opinion besides. We have been fortunate enough to secure a number of specimens from cases of Paget's disease and conditions closely simulating it, including five cases which we would positively identify as true Paget's, and in view of the lack of unanimity

of opinion among pathologists, and the vagueness of the views held by many clinicians, as well as the fact that, as pointed out, this is a relatively large amount of material, we have been led to report the results of our studies in some detail, and to abstract and analyze the work done by previous investigators. We are indebted to Doctors Edward Martin, Charles H. Frazier, William L. Rodman, George M. Laws and W. C. Clarke for the loan of material and permission to publish their cases. The specimens from these cases and from our own have been studied in Dr. Speese's Laboratory of Surgical Pathology in the University of Pennsylvania.

It may not be amiss to dwell here on the reasons which have led to so great an amount of interest in what is in reality a rare disease, for that true Paget's disease is rare, all authorities agree, and fortunately some figures are available to prove this assertion. G. T. Jackson stated that in the statistics of the American Dermatological Association from 1877 to 1893, which embraced 204,866 cases, there were none of Paget's disease included, while in 1894 there was one case in 24,321. He collected 45 cases reported up to 1896 but did not claim that this embraced all cases in the literature. Hannemuller and Landois in 1908 stated that about 100 cases had been published up to that time and Reuter in 1912 found about 130 cases, while Dr. Joseph MacFarland of Philadelphia, who has also been pursuing some studies on the subject, informs us that he has references to about 150 cases to date. It will be seen that the number of cases grows steadily but slowly. M. B. Hartzell in 1910 collected 18 cases of extramammary Paget's disease, and we have not found any later estimate of the number of cases to be added to this class.

The reason for the great amount of interest taken in the disease undoubtedly lies in the hope that has been stimulated from time to time that in its study may be found a sequel to the cancer problem. Paget's paper, pointing out as it did that cancer followed closely on the heels of what he believed to be ordinary eczema or psoriasis occurring on the nipple and areola, and the comparisons which he drew to the development of cancer on other parts of the body which are the sites of chronic irritations, and the deductions which he made as to the dependence of such malignant changes for their origin on the chronic irritations described, was calculated to instil this hope. The first histological studies were those made by Butlin and George Thin. Butlin studied four cases operated by Paget, Savory and Smith, and thought he could trace a direct relationship between what he still interpreted as eczema on the surface, and carcinomatous changes de-

veloping secondarily, while Thin was the first to demonstrate the sharp distinction between the skin changes and true eczema, and also the first to claim, as a result of his studies of six cases, that the superficial lesion was secondary to duct carcinoma, which caused connective tissue destruction in the skin by the action of what he called a connective tissue poison, viz, cancerous epithelium. This explanation of Paget's disease was not accepted by Duhring and Wile, whose studies were prosecuted soon after, and who made another notable contribution based thereon. The next stage in the history was that marked by the startling claims of Darier and Wickham, who were impressed by the peculiar nature and appearance of the cells in the deeper layers of the epiderm, which are now recognized as characteristic of this affection, and believed that they were able to identify in them the psorosperms or coccidia which were the cause of the accompanying malignant disease of the breast. The inference was naturally drawn from such a claim of discovery that the long sought for cause of cancer was here uncovered. Further histological studies soon showed, however, the true nature of these cell forms to be the actively dividing, deeply-staining nuclei, and the changes produced by fixing agents in the oedematous cells of the rete mucosum, and the compression and alterations in shape and location of other cells in their immediate neighborhood, with the bizarre picture so produced.

The overthrow of Darier and Wickham's theories was marked by a return to the views of Duhring and Wile, and first Karg and then Unna recognized in Paget's disease, as Thin had said years before, an affection differing from any other known skin disease, entirely unlike eczema or psoriasis or any ordinary catarrhal process, Karg regarding it as a superficial malignant process marked by oedema of the prickle cells, while Unna looked on it as a unique affection differing as widely from cancer as from eczema. Thin had almost from the beginning regarded the characteristic epidermal changes as secondary to duct cancer, as he called the impactions in and infiltrations extending from the lactiferous ducts, while Ely had made similar deductions in the study of the first case reported by G. T. Jackson, deductions which were vigorously combated in the discussion before the American Dermatological Association. It was mainly due, however, to the paper of Jacobaeus, followed up and supported by the articles of Schambacher, Ribbert and Kyrle, that the present day conception of Paget's disease as a secondary manifestation of breast cancer is due, a conception which is not shared by dermatologists, and whose upholders are by no means in unison when they come to the question as

to how the various changes in the epiderm and corium are produced To the dermatologist to-day, Paget's disease appears as it did to Duhring, Karg and Unna Sequeira, Stelwagon, Hartzell, Knowles and other authorities regard it as a peculiar affection, primary in nature, not confined to the breast but occurring in any locality, of rare occurrence; by some classified as frankly malignant and by others as showing no true characteristics of malignancy in its histology but followed sooner or later in a large percentage of cases by the development of malignant disease in the underlying tissues

We have outlined the history of this interesting lesion in an attempt to show the interest which has always attached to a subject which occupies a borderline position between surgery and dermatology We would add here that our own studies have led us to adopt the views of the dermatologists and to regard it as a primary condition, whether occurring in the breast or other regions, views which have been adopted by those men who have been thoroughly trained by the study of the histology of skin affections, and who have not only paid close attention and given due weight to the clinical as opposed to the purely pathological aspects of the question, but who have had the opportunity, not frequently offered to surgeons, to study the lesion in other parts of the body where its histology is not obscured by changes in the mammary gland, which are notoriously baffling and confusing and require long experience to properly interpret

The clinical picture of Paget's disease when it involves the nipple is well known, and it would seem that it should not admit of misinterpretation when fully developed It has been remarked by others that the description of Paget holds as true to-day as when it was penned by that master of surgery, and this is true although the study of many cases since has naturally enabled us to add to it and fill in many details and to describe better its beginnings and its variations from the classical type He says, "The patients were all women, varying in age from 40 to 60 or more years, having in common nothing remarkable but their disease In all of them the disease began as an eruption on the nipple and areola In the majority it had the appearance of a florid, intensely red, raw surface, very finely granular, as if nearly the whole thickness of the epidermis were removed, like the surface of very acute diffuse eczema, or like that of an acute balanitis From such a surface, on the whole or greater part of the nipple and areola, there was always copious, clear, yellowish, viscid exudation The sensations were commonly tingling, itching and burning, but the malady was never attended by disturbance of the general health" It

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is not improbable that Paget made the mistake, not uncommon to-day, of including in his series some cases which were not true examples of this affection, but were cases of scirrhus carcinoma with secondary skin involvement. For example, when he goes on to speak of less frequent types which he has seen "In some of the cases the eruption has presented the characters of an ordinary chronic eczema with minute vesications, succeeded by soft, moist yellowish scabs or scales and constant viscid exudation. In some it has been like psoriasis, dry, with a few white scales slowly desquamating, and in both these forms, especially in the psoriasis, I have seen the eruption spreading far beyond the areola in widening circles or with scattered blotches of redness, covering nearly the whole breast." The latter part of this quotation might be used to describe certain rare types of diffuse carcinoma of the breast, which do not at all resemble in their pathological and microscopical features true cases of Paget's. We have recently encountered a very early case of diffuse carcinoma of this type, in which there were associated with a dry and limited eczema of the nipple and long standing retraction of the same, widening circles or portions of circles of reddening in the skin, at a little distance from the nipple, resembling telangiectatic areas, without ulceration of the nipple and without tumor formation clinically, the breast being only slightly larger and heavier than the opposite side, but in which, after amputation had been performed, the microscope revealed very early and diffuse scirrhus carcinoma. In this case we made the mistake of suspecting Paget's disease (Fig 2)

M. A., sixty-eight years, a widow, two children, one living. A sister died of cancer of the breast. The left breast had always been small and rather hard and the nipple somewhat retracted. Four months ago noted some reddening of the overlying skin and increased hardness of the gland. No pain. Examination shows a diffuse pinkish redness of the skin over the breast, patchy in distribution, and some roughening of the areola. The breast seems slightly larger and heavier than the opposite side and denser, but not with the stony irregular hardening of cancer but of an elastic or springy density, and it is only slightly more tender than the right breast. There is no discharge from the nipple and no fixation of the breast on the underlying muscles. No lymph glands are palpable in the axilla. The patient has lost twenty pounds in the last year, and has  $1\frac{1}{2}$  per cent of sugar in the urine. Operation was advised, and performed a few days later under gas-oxygen anæsthesia. The breast was removed with the overlying skin and the pectoral fascia. Macroscopic examination by

Dr Speese in the operating room showed no evidences of cancer. The axilla was therefore not dissected nor the muscles removed. In this case, an erroneous diagnosis of Paget's disease was made before operation.

*Pathologic Examination*—5678 Specimen consists of a breast with slightly inverted nipple and showing several concentric rings, red in appearance about the areola. There is no distinct excoriation present, although the skin appears scaly. On cross-section through the breast the tissues are dense and fibrous in nature and the entire breast is the seat of this transformation. The tissue cuts with a slightly increased sense of resistance, the entire picture resembling the fibrous type of chronic cystic mastitis. While the gross appearance did not suggest malignancy at the time of operation the breast was amputated on account of the patient's age and the diffuse fibrous overgrowth.

*Microscopic Examination*—The fibrous tissue when examined was infiltrated by a scirrhous carcinoma in a small area situated beneath the nipple and 4 cm from the surface. Elsewhere the usual picture of a chronic cystic mastitis was present. In the subcutaneous tissues in areas covered by the reddened skin, an interesting picture is noted, here small plugs of epithelial cells are found in the lymphatics, the process resembling a lymphatic metastasis extending from the malignant area below and travelling toward the skin. These emboli are numerous and three and four may be found in a single field (Fig 4), but in no instance are they noted invading the skin.

The process represents a form of carcinoma diffuse in nature, rarely encountered and difficult to recognize grossly because it was found in a breast the seat of chronic cystic mastitis. The malignancy was so early that the distinct gross manifestations of cancer had not appeared. The metastatic emboli may be the beginning of a cancer *en cuirasse*, and it is noteworthy that they were found only in the subcutaneous tissues covered by the reddened skin.

In the very early stages of the disease, the lesion shows itself as a small, indurated area, covered perhaps by a crust or scurfy covering, the nipple slightly reddened around it, and a little itching or burning as subjective symptoms. As it spreads, the ulceration, which is accompanied by connective tissue inflammation and which separates it sharply from eczema and psoriasis, becomes more apparent, and, while scabbing may be present, beneath the incrustated detritus and dried secretions the characteristic appearance, as described by Paget, will be found. A very characteristic appearance is furnished by those cases in which bluish-white areas of epiderm deck the surface here and there, while the boundary edges of the ulcer are sharply defined. Beneath the surface of the ulcerated area is a characteristic thin, flat area of infiltration, somewhat chancre-like in its density, and when pinched between thumb and finger has been likened by English writers

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in its feel to a penny felt through a cloth. The nipple itself becomes flattened and undergoes, in time, absorption by ulceration or, when cancer develops early in the breast, it soon undergoes characteristic retraction due to traction on the milk ducts. These changes may extend over months and years. In very long standing cases the disease spreads slowly from the areola over the skin of the breast, even perhaps to the axilla, and may exist for five, ten, fifteen or even twenty years without seriously affecting the general health or presenting those evidences of deeper malignant disease of the breast which Paget saw in all his cases which he followed, and which usually develop in two or three years and which are the common but perhaps not inevitable ending.

It is commoner in married than in single women and affects the right breast oftener than the left, is very rare in the male breast, but has been described there. In the later stages a tumor develops in the underlying gland, usually beneath the nipple, which tumor varies in size with the stage of the disease, and is followed by axillary enlargements and the usual evidences of cancer.

The above description holds true of the great majority of cases of Paget's disease, but there are exceptions. The most significant of these is that a goodly number of typical cases, fulfilling all the demands which a microscopic diagnosis entails, are found in other parts of the body. Duhring, Fordyce, Dubreuilh, Fox and MacLeod, and others have written critically and more or less extensively on this phase of the subject and M. B. Hartzell collected, in 1910, 18 cases of extramammary Paget's disease. Among the regions affected were the scrotum and penis, glans penis, perineum, vulva, pubic region, umbilicus, axilla, neck, nose, lower lip, buttock and arm. Nine of these cases were on the external genitalia or adjacent parts, including five on the glans penis. When it arises in the axilla it may spread to the breast, the reverse of the usual course, and as in Jungmann and Politzer's case may, after a course of nine years, terminate in a pavement-cell carcinoma in that site. It is now marked by a rapid and now by a chronic course. It may affect the virgin or the multiparous woman. A family history of cancer is not common. Both breasts have been seen to be involved and it has developed in the remaining breast after one has been removed for tumor. Whatever the clinical course and symptoms may be, or may simulate, the histological examination either confirms or refutes the diagnosis.

Cases of simple eczema of the nipple, of primary carcinoma of the breast with excoriation or ulceration and destruction of the nipple or of the skin in its neighborhood, papillary cystadenoma attended by



discharge from the nipple, the rare form of diffuse carcinoma with early involvement of the skin of the type which we have mentioned, and one or more types of the very rare primary tumors of the nipple as reported and collected by Battle and Mayberry, Linfors and Schreiner, may cause errors in diagnosis. The commonest error would seem to be the inclusion of cases of ulcerating scirrhus, and this conclusion we have reached as a result of our study of a number of these cases, in several of which a diagnosis of Paget's disease had been made by a very distinguished surgeon, in some of which the clinical history was strongly suggestive and in some of which it was entirely lacking. It has only been after the study of many dozens of sections of tissues in some of these cases, that we have been forced to discard them as examples of Paget's disease or malignant papillary dermatitis, as it is sometimes called.

We have already quoted Paget's original description of the clinical appearance and symptoms. He distinctly states that he saw no difference in the process from long standing eczema or psoriasis. As to the cancers which follow, he states that he saw in them nothing peculiar or differing from ordinary cancer in the course they pursued. The noteworthy fact has been their development following a chronic irritation which he likens to the persistent "rawness" which may precede cancer on the glans penis, and the chronic irritation on the lower lip and the superficial syphilitic disease of the tongue, which are followed by cancer in these localities. The superficial disease induces a degeneration in the very susceptible sites mentioned, which causes them to become the seat of cancer, and he mentions the pylorus, ileocaecal valve and rectum as perhaps being affected in a similar manner from similar surface irritations.

The first histological studies of Paget's disease were made by Butlin, who examined four cases. He noted the epithelial proliferation in the ducts as well as the changes occurring in the skin, and demonstrated the presence of carcinomatous infiltration in the breast itself. He believed that there was a definite relationship between the "eczema" and the cancer, and that the former produced a proliferation in the mucous layer of the epiderm. The process then extended from the skin to the milk ducts and thence to the smaller ducts and acini, and finally terminated as cancer.

George Thim first called the disease malignant papillary dermatitis. He studied 6 cases and described the usual cell changes due to degeneration, including vacuolation, etc. He distinguished the affection from eczema by the history, the well-defined margin and the infiltration

of the papillary layer. He pronounced it different from any known skin disease, and, as already mentioned in speaking of the history of this subject, concluded, as the result of his studies, that the process was secondary to duct carcinoma and was caused by some irritating agency arising in the ducts. He distinguished the cancer which developed from ordinary scirrhus.

Duhring and Wile emphasized the encroachment on and obliteration of the papillæ of the corium by the downward proliferation of the cells of the rete. They believed that the disease was an abnormal epithelial cell proliferation beginning in the rete Malpighii, which extends secondarily to the milk ducts and spreads downward to the deeper ducts, breaks through their thinner walls, and as cancer spreads upward toward the skin surface.

Darier and Wickham added to our knowledge of the clinical features as to time of development, early symptoms and anatomical features. They emphasized important points in differential diagnosis and described the histological appearance of Paget's disease on the breast as well as elsewhere. They believed the affection was due to psorosperms or coccidia which they described in the deep layer of the epiderm.

Bowlby, as a result of his study of a large number of cases, demonstrated the fact that there was a definite histologic picture of Paget's disease as described by his predecessors, and looked upon the affection as precancerous and not in itself malignant.

Karg regarded the condition as a superficial cancer and described the active proliferation of epithelium in the skin in advanced cases, with a breaking through into the underlying tissues.

Unna, in presenting one of the most satisfactory descriptions of the pathology of Paget's disease, definitely disproved the psorosperm theory of Darier and Wickham. He regards it as a unique lesion, not primarily malignant, but comparable with such other dermatoses, precancerous in nature, as xeroderma pigmentosa and sailor's skin. It is as different from cancer as it is from eczema and, while it does not lead directly and necessarily to cancer, it prepares the ground for it so thoroughly that cancer develops in most cases. Like Duhring, Wile and Karg, he recognizes the typical and important changes in the shape of peculiar degenerations of the prickle-cells which he regards as a peculiar form of epithelial œdema. The nuclear changes, loss of fibrillation, vacuolation due to the action of fixing agents, compression forms and diminished cornification, are all clearly described. The sub-epithelial infiltration, described by all investigators, he calls a bul-

wait and regards it as a defensive process. The cancer which follows may begin in the skin, the lactiferous ducts, or in the breast itself. He does not admit a direct transition of the skin disease into cancer.

Shields's case proved that a long standing lesion, involving an area covering the skin of the entire mammary region, could after seven years terminate in a squamous cell carcinoma without involvement of the glandular structure of the breast.

Fordyce has described clinical and pathological characteristics and, while looking upon the disease as a primary one when it occurs in the breast, favors the view that it is malignant from the start, and difficult to separate from certain types of epithelioma.

Dubreuilh, in reporting a case of Paget's disease of the vulva, looked upon the affection as a superficial epithelioma, which invaded the mucous glands in the same way it did the skin follicles, thus finding an early pathway to the deeper tissues which makes the disease more serious on mucous surfaces. He mentions the minor differences in its behavior on mucous surfaces as compared with the growth on skin surfaces.

George T. Jackson reported two cases which had been studied carefully, one by Ely and the other by Schultze. Ely regarded the process in the first case as secondary to a non-malignant type of breast tumor, probably a pericanalicular fibroma. Schultze looked on the process as distinctly inflammatory and not epitheliomatous. He said that in the present stage of our knowledge, the genetic connection between Paget's disease and carcinoma of the breast remained a matter of speculation, the processes being essentially different.

T. C. Fox and J. H. M. MacLeod reported a case of Paget's disease of the umbilicus of eleven years' duration and compiled an excellent resume of the literature. They collected cases of extramammary lesions reported by Radcliffe Crocker, Darier and Coulland, M. Shields, Dubreuilh, Fordyce, Tarnowsky, Pick, Winfield and Ravogli. Fox and MacLeod agree that the histological changes described are characteristic and pathognomonic, regardless of where the lesion occurs. Also, that in their case there was no definite malignant change present, and they do not regard the process as primarily malignant but, like xeroderma pigmentosa, ordinary warts and pigmented moles, it is a precancerous lesion with malignant potentiality. They point out that it is both unproven and unlikely that the degenerated cells present in the epiderm can take on malignant characteristics, but think it more likely that a prolonged action of the same cause which produced the degeneration may in non-degenerated cells cause their reversion and proliferation.

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They suggest that the process starts in the corium from some irritation beginning in the blood-vessels, either in response to locally implanted microorganisms or a poison produced by an irritant acting on the epidermal cells. The inclusion of a portion of Meckel's diverticulum in the umbilicus in their case was interesting but the congenital rest showed no malignant changes whatever.

The observations of Jungmann and Politzer indicate that the primary process is not necessarily a malignant degeneration of the cells in which Paget's disease begins, because the cancer which finally arises may occur not only in the epiderm but also in the glandular offshoots of the skin (follicles, etc.), in the ducts and in the glands of the breast. The case which they studied originated in the axilla as a small, red, moist spot, which gradually enlarged and in four years' time extended almost to the nipple and arm. Improvement followed X-ray treatment, after which sections were taken for microscopic examination, which showed that the process was a primary squamous carcinoma arising in the skin and extending to the axillary lymph-nodes. The authors were unable to state what the nature of the primary skin affection is but gave it the name of "*dermatitis epithelialis circumscripta chronica eczemiformis*."

The conclusions of Jacobaeus, based upon a study of three cases, have influenced many writers on the subject of Paget's disease. His explanation of the nature of the disease does not seem warranted in view of our present knowledge, both clinical and pathological. Jacobaeus concludes that Paget's disease is carcinomatous from the beginning, and arises in the gland epithelium of the ducts. The changes in the skin are due to proliferation, and extension into the skin, of cancer cells originating from glandular epithelium. The Paget cells are not locally degenerated epithelial cells, but metastatic cancer cells, and similar changes occur when the usual form of adenocarcinoma ulcerates through the skin. The late appearance of a cancer points to the benignancy of the primary affection, and is due in part to obstruction to the growth of the tumor exerted by the connective tissue and possibly the striated muscle. A direct connection between the Paget cells and the cancer cells was traced in two cases, this fact is substantiated by the fact that Paget's disease begins at a place where its primary origin can be traced back as well to gland epithelium as to the skin, for it arises where the ducts empty, and here the epithelium is modified.

Schambacher does not agree with the view that Paget cells represent locally degenerated cells of the skin, rather he regards them as not

arising in and having nothing in common with the epiderm. He states that the cells of the epiderm and Paget cells differ in many ways, they are separated sharply from one another, the Paget cells do not possess intercellular spines, and do not show the arrangement of squamous epithelium. He says the process is carcinoma from the beginning, it extends to the skin, causing compression and death of the epidermal cells, first attacking the lower layers. He explains the process by assuming that the cancer arises in the nipple, then extends to the skin and ducts, and finally blocks off the latter, causing the dilatation found in most cases.

Ribbert also regards the cancer in the ducts as the primary process. He did not find any tendency of the Paget cells in the skin to infiltrate the subcutaneous tissues and form a malignant degeneration. He noted in only a few places a connection between the Paget cells and the carcinoma.

v Winiwarter believes it to be a special form of skin cancer with a characteristic course, and its relative benignity allies it to *ulcus rodens*, and states that these two rare forms mingle with each other and with other skin cancers and lead to numerous misunderstandings.

Kyrle also assumes that the breast tumor is the primary affection and the Paget cells in the skin represent the regionary metastases, the cells spreading in the lymph channels in a retrograde manner, *i e*, toward the nipple. This form of extension of a breast cancer is only a deviation of the type of extension seen in the lenticular form of cancer and in *cancer en cuirasse*. Kyrle concludes that Paget's disease has no common pathological and anatomical basis, for in one case a squamous cell carcinoma may be present, in another, a cylindrical cell or gland carcinoma, indicating that the disease may originate respectively in the nipple, the milk ducts or the parenchyma of the breast.

Hannemuller and Landois lay great emphasis upon the different morphology of the Paget and the cancer cells. They contrast the difference in size and staining properties, and state the two cells differ in type as much as is possible for any two varieties of cells. They think a retrograde metastasis must be assumed to account for the presence of these cells in the skin, but believe it is difficult to explain why only the squamous epithelium has received the invasion of cancer cells, while the underlying connective tissues remain free. They conclude, as the Paget cells only occur where the chronic granulation tissue comes in contact with the skin, that the latter is largely responsible for the changes induced in the cells, and that in consequence of the long continued secretion on the ulcerated surface, the cells become

so injured that a swelling of the protoplasm results through alterations in osmosis and diosmosis, finally causing the typical Paget cell

Hirschel believes with others that cancer is primary

M B Hartzell brought the number of cases reported in extramammary regions up to 18, including one of his own, occurring on the arm in association with a nævocarcinoma From personal communications with Dr Hartzell we learn that he strongly favors the primary origin of Paget's disease and controverts the assertions of Jacobæus and others as to its secondary nature

Surgeons in this country who have expressed their views comparatively recently on this subject include J B Murphy and Wm L Rodman, both of whom look on Paget's disease as a secondary condition, the former, Murphy, frankly siding with Jacobæus and his school in stating that the skin changes arise in primary duct cancer in response to an irritating discharge from the milk ducts, causing irritation and subsequent ulceration of the nipple, and he calls it Paget's cancer instead of Paget's disease We have already given Hartzell's present views Stelwagon informs us in a personal communication that like Hartzell he is a firm adherent of the primary and distinctly independent nature of Paget's disease as is Sequeira, and Knowles takes the same view, while Ormsby states that the connection between it and malignant breast disease is not settled but that most authorities look on Paget's disease as benign and precancerous He has had three cases extramammary in location.

*Pathology*—The descriptions of the pathological changes found in Paget's disease have almost without exception been uniform in character The differences in opinion consist in various views as to the cause and origin of the affection rather than in the histologic manifestations of the disease The characteristic changes described when it occurs in its common site comprise alterations in the skin and corium, and what are probably secondary changes in the milk ducts and glands of the breast, and of these the greatest interest and speculation have centred in the peculiar appearance of the epiderm, and the question as to its primary or secondary occurrence

The changes consist in a thickening of the skin caused largely by proliferation and growth downward of the rete mucosum, the cells of which, however, do not exhibit invasive tendencies, a fact particularly emphasized by practically all writers on the subject The interpapillary bodies themselves are thickened and present a rounded appearance and in some cases encroach upon the papillæ to such an extent that they are almost obliterated The epithelial cells in this layer are the seat of the changes which give to the disease its peculiar

character Beginning probably in the prickle-cells, and extending gradually to the basal and then to the more superficial cells, the disease produces a peculiar swelling and vacuolation The cells are greatly increased in size, the protoplasm is clear or finely granular, and the nuclei are large, vesicular and show many irregular mitotic figures As the process advances almost the entire thickness of the epiderm becomes involved, and only an occasionally normal cell is seen The degeneration of the prickle-cells becomes so complete that their characteristics are lost Keratin formation, intercellular spines, and fibrillation cannot be demonstrated in the cells which have undergone vacuolation This fact has been used by some writers to indicate that the Paget cells are not derivatives of the epiderm It seems more rational, however, in view of their regular distribution in the rete, and in the absence of characteristics of gland epithelium, to assume an alteration in the cell characteristics by which they lose their innate peculiarities, than to explain their presence by a process of metastasis unlike that observed in any other form of breast cancer The superficial layer of squamous cells is frequently preserved in certain areas, and shows the usual characteristics of keratinization Unna describes other forms of cells in which the appearances are modified by resistance of the hardened outer layer, as in the upper layers of the rete, also the changes due to compression of neighboring cells, development of "encysted" cells, etc In more advanced stages of the disease ulceration results in a disappearance of the epiderm, so that the inflammatory tissue produced in the corium is exposed and forms the base of the ulcer The edges of the lesion exhibit in sections under the microscope an abrupt change from the normal to the diseased epiderm

The inflammatory reaction, or as some believe the initial manifestation of Paget's disease, consists in an intense cellular collection which appears under the epithelial layer in the corium, or to a lesser extent about the ducts and acini, which subsequently undergo proliferation of their epithelial cells The infiltration for the most part consists of round cells, although many plasma cells and a lesser number of connective tissue cells and leucocytes are noted Unna speaks of this as a pure plasmoma which acts as a bulwark The zone of reaction seems to vary in accordance with the skin changes We have noticed the most intense reaction in those cases in which Paget's disease is most advanced, and, when ulceration arises, the cellular infiltration reaches its maximum It too is sharply bounded by the edge of the lesion Many new blood-vessels with thin walls and resembling those found in granula-

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tion tissue are met with, in fact the entire process has been likened to that seen in a granulating wound

The superficial milk ducts contain a large number of cells in a stage of active proliferation, and in some instances the duct becomes filled with epithelium. Occlusion most likely occurs near the nipple, for cyst formation is frequently seen, the dilated duct being filled with debris, degenerated epithelial cells and fat droplets. The epithelium itself shows the changes occurring in any actively proliferating process. Some writers have described changes similar to those noted in the skin, and have traced a transition from one cell to another. In our cases we have encountered cells with clear protoplasm and presenting an appearance somewhat resembling the Paget cell, but it must be remembered, however, in many breast tumors both benign and malignant, large, clear, apparently vacuolated cells are met with and that these conditions are regarded as evidence of an active epithelial hyperplasia. The transition between the so-called Paget cells of the skin and the cells in the ducts or in the cancer has been traced by a few writers. The majority of observers have not noted such transition forms. In other cases, and particularly in extramammary Paget's disease, the extension of the process from the skin to the lining cells of the ducts, glands or follicles has been observed. In serial sections we have been able in one case to trace the ducts to their point of opening, at which site the superficial epithelium has been the seat of Paget's disease, but transition forms or the extension of Paget cells from the skin to the ducts could not be demonstrated. Finally the epithelial hyperplasia becomes so active in the smaller ducts and acini that the cells break through the wall and infiltrate the breast stroma as a malignant tumor. As pointed out by Duhring, this process usually is met with in the ducts one or one and one-half inches from the nipple, a fact which we were able to corroborate in two of our cases.

The malignant tumor, which develops in the majority of cases, springs from the epithelium of the ducts, less frequently from that of the acini, and rarely from the cells of the epiderm. There are undoubted examples of Paget's disease in which this latter type of degeneration has occurred, resulting in a squamous-cell carcinoma, and this fact in itself supports the opinion that the disease is not primarily a duct cancer, but a precancerous condition. The carcinoma originating in gland or duct epithelium resembles the type usually encountered in the breast, viz., adenocarcinoma or scirrhus carcinoma. These and other pathological characteristics are described in the studies of our cases which are appended and, with the interpretations which are



placed upon them by other authors, are included in the review of the literature

When we come to consider the arguments for and against the primary nature of Paget's disease, we find, as mentioned elsewhere, a great divergence of views. Many surgical authorities have been converted to the view that it is a secondary process by the articles of Jacobaeus, Schambacher and Ribbert, which are in effect a return to the views held by Thin. The reasons for this view are based primarily upon the very frequent association of breast cancer with Paget's disease when it comes to histological examination. Also, the superficial changes in the milk ducts, and the apparent connection of these with the diseased areas in the epiderm, and the changed appearance of the cells occupying the rete from that of the prickle-cells, which give them to some observers a resemblance to cancer cells and the cells in the lactiferous ducts, and which lead these observers to identify them as metastases. Other writers, who also uphold the view of the secondary nature of Paget's disease, regard the oedematous cells in this region as prickle-cells which have lost their characteristics by reason of the irritating discharge from the milk ducts, or by reason of diosmosis and osmosis from prolonged contact with the secretions bathing the ulcerated surface. These writers sharply distinguish between cancer cells and Paget cells. Jacobaeus claims in one case to have recognized cells identical with Paget's cells in ulcerating scirrhus, where carcinoma cells substituted the epithelial cells.

As against their views and supporting the conception of Paget's disease as an independent and more or less unique skin disorder is a mass of clinical and pathological evidence which the above-mentioned authors disregard or misinterpret. Cancer of the breast is common while Paget's disease is rare. Speese has examined 450 cases of breast tumor in the University Hospital service of which 2 were Paget's. Oldekop had 3 in 250 cases, and Guleke 7 cases in 782 breast tumors. The common testimony of surgeons of large experience is that they have seen not more than one or two cases. Paget's disease may, and often does, exist on the breast for many years. Such is not the history of malignant disease of a glandular type. There are cases on record in which no cancer in the parenchyma has developed after many years. There are cases in which squamous carcinoma has developed from long standing Paget's disease and then pursued its characteristic course. Paget's disease develops in many other regions, and while it occurs by preference on areas rich in surface glands, it arises and pursues its usual course on such regions as the buttock, the nose,

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the neck and the axilla. As regards the histological appearance, it does not resemble that found in any region where an underlying carcinoma frankly ulcerates through the skin. We could not confirm Jacobæus's unsupported observation in this respect, after study of a large series of ulcerating cancers of the breast and other organs. We agree with those authors who find no resemblance between Paget's cells and cancer cells, nor have we been able to trace transitional forms from the cancer cell to the Paget cell. The absence of a direct invasion downward of the corium by the Paget cells is against its being of a malignant or metastatic nature. The development of squamous carcinoma in this and other locations is another argument against its secondary nature and strongly in favor of its classification as a precancerous lesion wherever it arises. We believe that the key to the solution of the problem as to whether the disease is primary and spreads from above downward or secondary and proceeds from below upward, is provided by the study of cases occurring elsewhere than the breast, where the question of irritating discharges and metastases from deep glandular cancers can be eliminated. It is significant that dermatologists who have had almost a monopoly of such cases, while they may differ among themselves as to whether Paget's disease is in itself precancerous or malignant, are almost a unit in regarding it as a primary lesion.

*Treatment*—Little need be said as to the treatment except that which is summed up in the words "radical operation." The presence of malignant disease has been shown in the great majority of cases, and the impossibility of predicting its absence in any case. Tumor is absent in many cases clinically in which the microscope shows that infiltration has already occurred. These facts need only to be mentioned to indicate the importance of an early and complete operation. The treatment by X-ray has been disappointing in that, while the superficial lesion may be healed, the deeper malignant process in the breast progresses. The X-ray has proved of great benefit in some extramammary cases, where the location or the extent of the affection did not permit of its radical extirpation.

### CONCLUSIONS

1. Paget's disease of the nipple is a primary affection beginning in the cells of the rete Malpighi, potentially malignant, although lacking the ordinary characteristics of malignant disease.

2. It is identical with the disease known under the name of Paget occurring in other regions.

3 It is commonly, although not invariably, followed by glandular carcinoma in the underlying breast tissue

4 It is precancerous in the sense that it induces epithelial changes in the superficial milk ducts and acini, which are followed by carcinoma Occasionally, although rarely, it is followed by squamous cell carcinoma of the nipple

5 The disease is characterized by oedema and vacuolization of the prickle-cells, thickening of the rete, and active mitosis, also by an inflammatory reaction in the corium and a secondary hyperplasia in the milk ducts

6 It is sharply differentiated from true eczema and scirrhus carcinoma ulcerating at the nipple, and should not be confused with superficial metastases of diffuse cancer situated near the skin

7 The resulting tumors of the breast and the regional metastases resemble the type of breast cancer usually encountered When the tumor originates in the skin, it infiltrates and metastasizes in the form of squamous carcinoma

8 The common association of cancer in the breast with Paget's disease demands as the treatment for Paget's disease the radical operation which is practised in breast cancers in general

The histories of the cases of Paget's disease studied by us are appended Also a case of one type of ulcerating scirrhus which simulates it

CASE I—S F (Presbyterian Hospital, January 7, 1915, Dr J H Jopson), aged sixty-seven, no history of neoplasm in family, mother of 3 children, mastitis in right breast during lactation Present trouble began seven months ago in left breast when she noticed a little sore on nipple which dried up at first when powder was applied Later no healing possible and would bleed

*Physical Examination*—Elderly female, rather well preserved for her age General physical examination negative Left nipple twice as large as opposite, due to ulceration, nipple inverted, ulceration  $\frac{7}{8}$  by  $\frac{3}{4}$  of inch, shallow crater formed by erosion in centre The areola is healthy, no underlying induration in breast No palpable axillary nodes Ulceration epitheliomatous in appearance, pink in color, covered here and there with islands of new-formed bluish-white epithelium There is a constant exudation of serum No pain or burning, two small capillary naevi on breast (Fig 1)

*Operation*—Complete Halstead, no enlarged axillary nodes found

FIG 1

FIG 2

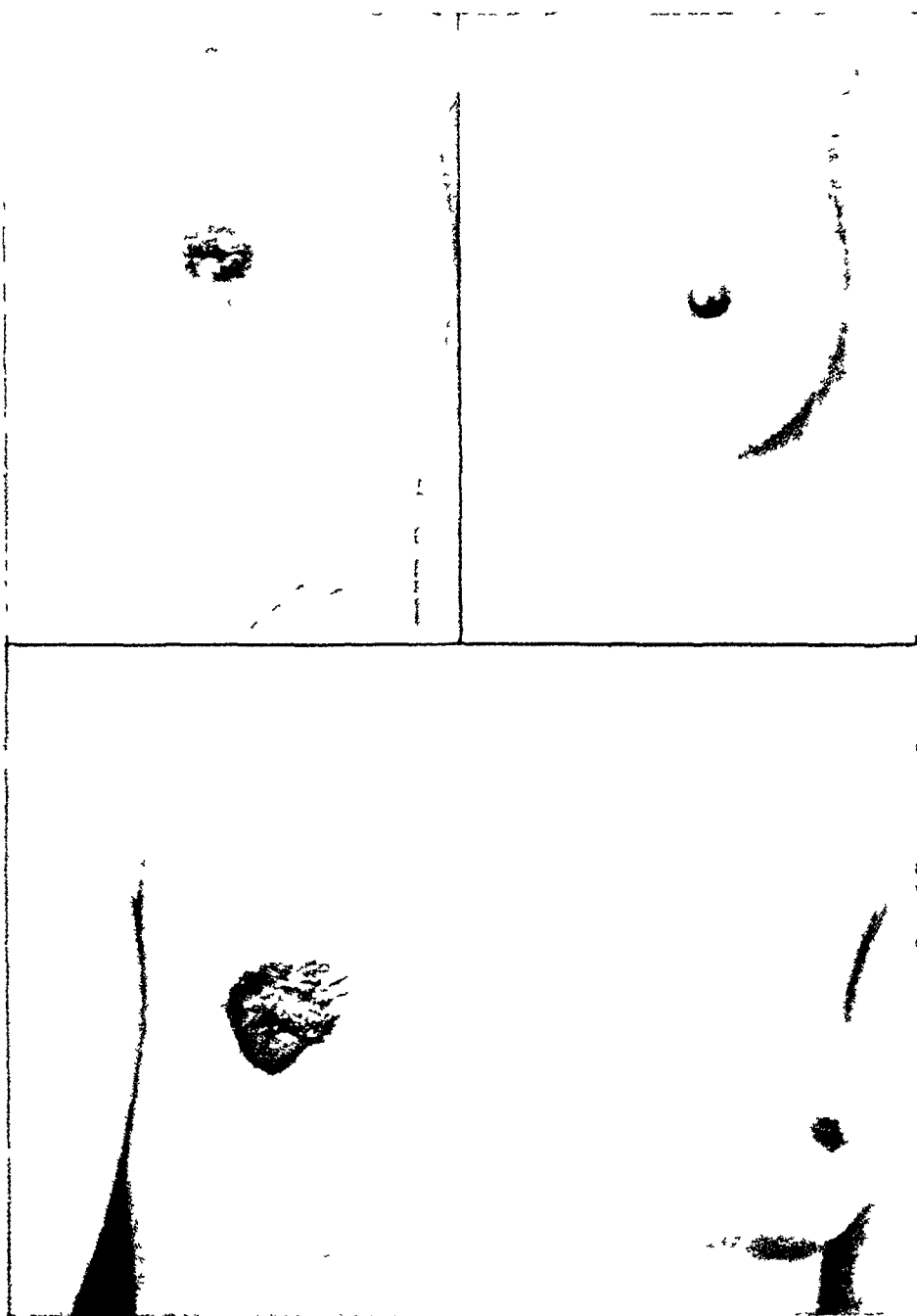


FIG 3

FIG 1 —Paget's disease of the nipple

FIG 2 —Diffuse scirrhous of the breast simulating Paget's disease

FIG 3 —Ulcerating scirrhous involving the nipple (Rodman)



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*Pathologic Examination*—5781 Specimen consists of a breast, pectoral muscle and axillary lymphatics. The nipple is slightly inverted, bright red in color and presents a superficial ulceration which is covered by several minute whitish areas resembling epithelium. The skin overlying the breast is normal. The areola is slightly pigmented and two small capillary naevi are noted on the surface some little distance from the nipple. Section through the central portion of the breast shows that the tissue immediately beneath the nipple is denser than normal but does not contain any of the gross evidences of malignant degeneration. The breast elsewhere shows a moderate degree of fibrosis occurring in the midst of a diffuse fatty overgrowth. In a few places this fibrous overgrowth is very dense and occurs in the form of small round nodules. The axillary lymphatics contain a few enlarged lymph-nodes which are apparently normal.

*Microscopic Examination*—Sections taken through the nipple and the tissues beneath show a stratified squamous lining covering the skin and the nipple, this is normal for the most part but as the region of the nipple is approached the character of the epithelium changes. The epithelial lining suddenly becomes thicker, the interpapillary bodies decidedly broader than normal and extend deeper into the corium than the adjacent normal ones. The most pronounced changes are encountered in the epithelial cells. These throughout the entire extent of the epidermis are enlarged, clear and vacuolated in appearance (Fig 5). The nuclei of the cells are enlarged and swollen and in many, irregular mitotic figures are to be seen. The condition of vacuolation has resulted in a disappearance of the intercellular spines in many of the cells, they are to be seen in some in the more superficial portion of the skin and particularly where the condition of vacuolation is less marked. While the entire thickness of the skin in some places is the seat of this condition (vacuolation), in other areas only the basal cells are involved and here keratinization of the overlying epithelium is well marked. Immediately beneath the skin is an inflammatory reaction which extends through the corium but only where it is covered by epiderm the seat of Paget's disease. In those situations in which a normal area of epiderm is encountered the subepithelial inflammatory reaction abruptly ceases to exist. The reaction consists of newly-formed blood-vessels with thin walls, surrounded with leucocytes, plasma cells and spindle connective tissue cells.

The sections taken through the milk ducts immediately beneath the nipple show several which are normal and others which are markedly altered in appearance (Figs 6 and 7). In the latter the epithelial lining has become heaped up so that in some instances the duct seems almost solid in appearance. In others the hyperplastic epithelium has caused an appreciable increase in the calibre of the duct and widening of the lumen. The epithelium is columnar, the cells contain granular protoplasm and the nuclei show many mitotic figures. In some instances the ducts can be traced directly to the opening in the nipple. Here the superficial epithelium is the seat of Paget's disease, but typical Paget's cells do not extend into the mouth of the duct nor does the epithelium lining the duct take on the characteristic changes of Paget's disease. About the ducts the seat of the most intense epithelial hyperplasia and to a less extent about the acini, an inflammatory

reaction similar to that beneath the skin is encountered. The changes described are found in the ducts immediately beneath the nipple, there is no tendency toward a breaking through of the elastic membrane of the duct. The epithelial hyperplasia extends to the ducts situated 3 and 4 cm beneath the nipple. Many of these are dilated, forming cysts containing a homogeneous structureless material and fat droplets. The epithelial lining in these cysts in some places has disappeared apparently by pressure atrophy, and in others is low and flat in appearance. In many of the ducts in this situation (3 cm from the nipple) the epithelial proliferation is no longer confined to the duct itself and outgrowths of solid plugs of epithelium are formed in the surrounding tissues. The first evidence of malignant infiltration is noted in a duct situated 1 cm from the nipple, the change is much more pronounced, however, in the ducts and acini situated deeper in the breast. In the surrounding breast tissue there is no evidence of malignant degeneration, but the glands are numerous and contain proliferating epithelium such as is encountered in the adenomatous type of chronic cystic mastitis. The lymph-nodes were unchanged.

*Summary*—The changes found in the skin are characteristic of Paget's disease. The inflammatory reaction, the hyperplasia within the ducts and the final malignant degeneration correspond to the series of changes seen in other cases. The case is noteworthy in that the connection between the superficial skin changes at the point of opening of one of the ducts could be traced. In this situation there is no indication of a substitution or metastasis of the hyperplastic duct epithelium into the epidermis as has been suggested by many writers, and, on the other hand, the Paget cells in the epidermis are not found in the ducts or in the acini. The case confirms the view that Paget's disease begins in and is limited to the epidermis, and that the cancer is secondary and is induced by the primary disease of the skin which in some unknown manner prepares the ground for a malignant degeneration.

CASE II—Mrs J S, aged fifty, patient of Dr C H Frazier. The patient is the mother of four children. There is no history of a neoplasm in the family. She was admitted and operated on for an umbilical hernia. During her convalescence she complained of pain in the left breast, when an examination revealed a reddened condition about the nipple. The surface was covered with scales and was constantly bathed in a thin watery secretion.

Amputation of the breast was performed and was followed by recurrence in two years for which several other operations were performed, death resulting four years after the first operation from extensive metastasis.

*Pathologic Examination*—2410. Specimen consists of a breast with underlying pectoral muscle and axillary lymphatics. The skin surrounding the nipple is red, covered with crusts, not infiltrated, the nipple is not retracted. The area of dermatitis is circular in outline and about two inches in diameter. Cross-section through the breast, including the nipple, shows a fibrous overgrowth but no distinct tumor formation immediately beneath

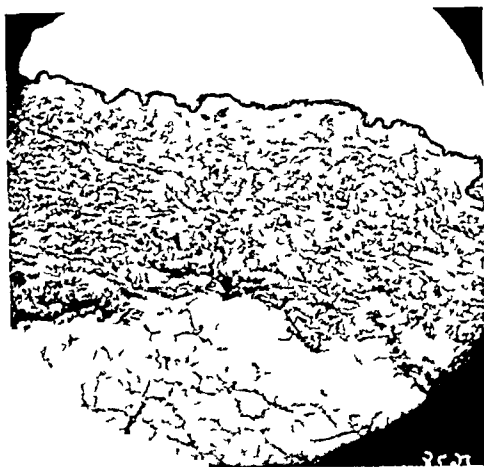


FIG 4—Histological appearance in case of diffuse scirrhus shown in Fig 2. Normal skin and emboli of cancer cells in lymphatics.

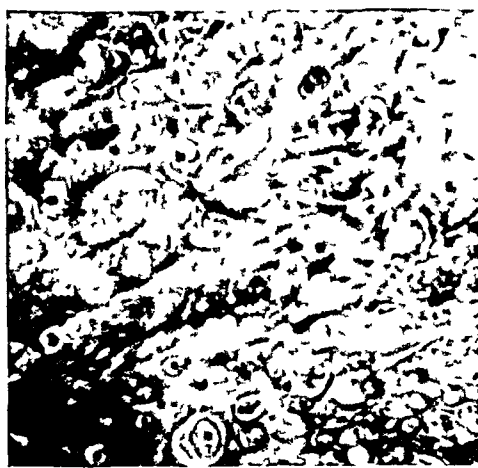


FIG 5—Case I. High power photomicrograph of the skin showing vacuolation and mitoses of cells in the prickle layer.



FIG 6—The squamous epithelium of the skin is the seat of Paget's disease; there is no involvement of the duct epithelium.



FIG 7—Dilatation of milk ducts and hyperplasia of the lining epithelium with a tendency toward infiltration of the stroma.





FIG 8 —Case II The entire epidermis is involved the cells enlarged and vacuolated

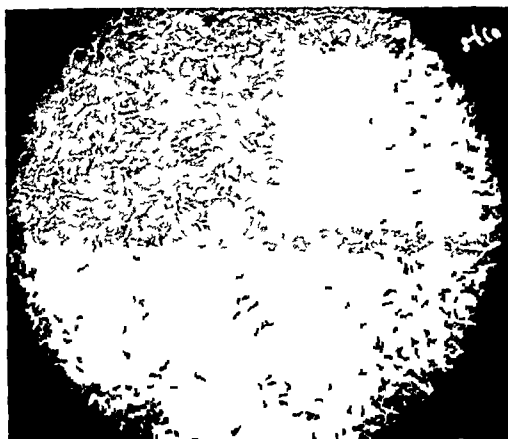


FIG 9 —Section from the tumor



FIG 10 —Metastasis to axillary lymph-nodes

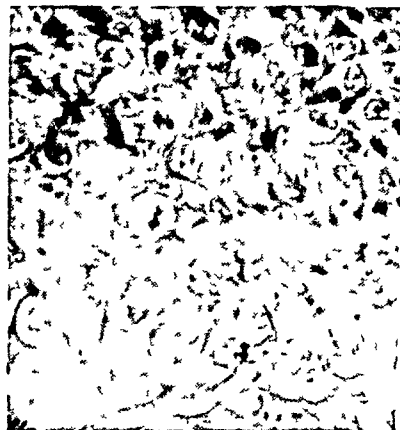


FIG 11 —The epidermis under high power showing characteristic vacuolation of cells



FIG 12 —Case III Vacuolation of the cells indistinctly seen Slight dilatation of ducts present but no infiltration of epithelium into stroma



FIG 13 —Case VI Section through nipple in an ulcerating scirrhus The squamous epithelium is unchanged the underlying tissues infiltrated with cancer

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the nipple In the upper and outer quadrant of the breast is a hard nodular mass 3 cm in diameter which on section is dense and white in color The surrounding areas of breast tissue show slight fibrous overgrowth In the axilla several enlarged lymph-nodes are present, and possess the same characteristics as the hard tumor already described

*Microscopic Examination* (Figs 8, 9, 10 and 11) —Section of the skin taken from the region of the nipple shows the greater portion of the epidermis to be transformed by a process which has caused pronounced vacuolation of the cells The greatly enlarged cells are clear or slightly granular in appearance, the nuclei vesicular and exhibiting many mitotic figures In a few areas intact portions of epidermis appear between areas the seat of these changes, and in these situations the line of demarcation is fairly sharp and only a few of the basal cells are vacuolated The cells immediately above appear unaltered and intercellular spines are demonstrated in the prickle layer In the epidermis the seat of the most pronounced transformation, all the cells are similarly changed and there is no distinction between the cells until the superficial layer is encountered where keratinization is noted In the corium is a diffuse reaction consisting of leucocytes, plasma cells and many capillaries The enlargement and swelling of the interpapillary processes has resulted in the occlusion and compression of the papillæ and in a few places has caused an apparent cutting off of the papillæ so that they seem to be included in the skin In the tissues beneath the nipple, a moderate dilatation of the ducts and hyperplasia of the lining cells are met with The opening of the ducts at the nipple could not be demonstrated The adjacent tissues contain large numbers of acini surrounded by round cells but no evidence of malignant infiltration The nodule in the upper and outer quadrant of the breast shows a definite carcinomatous process Many acini, lined with cuboidal epithelium and altered in shape by reason of pressure of the fibrous stroma, are present In other areas the tendency toward acinar formation is lost, and here the cells exist as small clusters containing a clear, almost transparent, protoplasm and deeply staining nuclei In the fibrous stroma a round cell reaction is noted The axillary lymph-nodes contain cells resembling those found in the breast tumor, the condition representing a metastasis

*Summary* —The case is to be regarded as Paget's disease of the nipple, with secondary carcinoma of the breast The epithelial hyperplasia in the ducts resembles that observed in other instances The case is of interest in that the carcinoma developed some distance from the nipple and ducts, contrary to most of the other cases observed by us, in which the superficial ducts or acini showed malignant degeneration

CASE III —Case of Dr George M Laws Mrs G, sixty-three, stated that the right nipple had always been smaller than the left, had been divided into two parts by a shallow cleft since birth and was always sensitive The family history was negative as regards malignancy She was the mother of four children and nursed three of them In February, 1911, she noticed a little moisture in the centre of the cleft Two months later a tiny scalc formed, the latter condition becoming progressively larger In

January, 1912, the cleft had widened, the nipple became flattened and ulcerated. This condition persisted until the time of examination, November 25, 1912, or twenty-one months after the beginning of the disease. The nipple was found to be entirely absent, there was a shallow ulcer 2 cm in diameter with reddened edges, although the surrounding skin was normal. There was a chain of pea-sized nodes along the border of the pectoral muscle. The breast elsewhere presented no distinct pathological changes. The ulcer and the surrounding skin were removed under local anæsthesia, and upon the report of Paget's disease radical operation was performed. There had been no recurrence or other disturbance when the patient was last seen, May 4, 1915.

*Pathological Examination*—4371 The specimen consists of a shallow ulcer measuring 2 cm in diameter and 0.5 cm in thickness, it is surrounded by an area of skin which presents no gross pathological features. The subcutaneous fat is unaltered.

*Microscopic examination* shows remnants of the epidermis, which for the most part has disappeared and its place is occupied by a mass of inflammatory tissue. The latter is represented by large numbers of leucocytes, plasma cells and newly formed blood-vessels and extends a short distance into the subcutaneous tissues and parallel to the entire surface of the skin ulceration. In the sections in which the epiderm is preserved it is found to be the seat of noteworthy changes. The cells of the basal layer, and to a much less extent in the superficial layers, present a condition of marked vacuolation, the cells being in some cases 2 or 3 times the size of the ordinary cell. The nucleus in some instances has disappeared, in others it is enlarged and irregular in appearance, in other cells mitotic figures are present. While some of the cells are clear the protoplasm in others has a granular appearance. Where the vacuolated condition is well marked a thin outline denotes the cell limits and intercellular spines cannot be determined, these appear, however, in the more superficial layers of the epidermis. In the subcutaneous tissues a downgrowth of epithelium from the epiderm or an infiltration of epithelium from other sources cannot be demonstrated (Fig 12). In one area one of the superficial milk ducts is encountered, it is surrounded by an intense round cell infiltration resembling that seen in the skin. The epithelium in the duct is hyperplastic and has undergone desquamation so that the duct is partially filled with cells, a few of which contain clear protoplasm and resemble somewhat the Paget cells of the epiderm. The elastic tissue surrounding the ducts is preserved and the proliferative epithelium has not infiltrated the surrounding tissues. An occasional acinus is seen, the epithelial lining has undergone proliferation but the surrounding tissue does not contain as intense an inflammatory reaction as was noted in that surrounding the ducts. The examination of the breast tissue removed at the second operation and the lymph-nodes does not show any changes suggestive of those already described. The breast is the seat of involution, the epithelium in the region adjacent to the nipple is normal.

## PAGET'S DISEASE OF THE NIPPLE

The histological study shows the characteristics of Paget's disease with the usual changes in the skin epithelium accompanied by an inflammatory reaction beneath. The surrounding breast tissue shows no evidence of malignancy, diagnosis therefore is that of Paget's disease which has not produced a definite carcinomatous process, but has provoked proliferation in the duct epithelium which in time would probably become malignant.

CASE IV—This case was submitted for study by Dr. William C. Clarke, S. S., aged fifty-three, had a lactation mastitis some years before the development of an eczema about the nipple which persisted for two years until the nipple was destroyed. There was an indefinite mass situated in the upper and outer quadrant of the breast. An area around the nipple was red and weeping without any significant loss of tissue. There were also several small cracks and the surface was covered with scales. This condition alternately dried up, then became fissured and bleeding. A mass was noted in the breast three weeks before operation, but could not be demonstrated in the gross specimen.

*Microscopic examination* (2441) of a section taken through the area of involved skin and extending well into the underlying tissues shows considerable thickening of the epidermis. The interpapillary processes are elongated and broadened. The epithelium shows numerous enlarged and vacuolated cells, the protoplasm of which for the most part is granular although in some places it is clear. The nuclei are enlarged and swollen in appearance and contain numerous mitotic figures. In the corium a very extensive inflammatory reaction is seen, this is associated with the formation of many new blood-vessels. The round cells extend into the papillae and into the epiderm itself. Evidences of epithelial hyperplasia are found in the ducts but not to the excessive degree noted in our other cases. A moderate cellular reaction appears about the ducts. Evidences of malignant degeneration are encountered in an area just beneath the skin and extending for a considerable distance into the dense fibrous stroma of the breast, the process apparently extending from below upward. The epithelium just above the area of malignant degeneration has disappeared and its place is occupied by a mass of inflammatory granulation tissue, the epithelium in the vicinity does not show the picture of Paget's disease.

The case represents Paget's disease with the usual changes in the skin, corium and ducts. It appears that the superficial ulceration is caused by the extension of the malignant area upward rather than to the action of the Paget's disease.

CASE V—Specimen was sent for study by Dr. William C. Clarke. The only available history stated that the breast was removed with the overlying skin and that some superficial excoriations existed for at least two inches about an atrophic nipple. The glandular tissue of the breast was atrophic and largely replaced by fat.

*Microscopic examination* (447) of the skin in the region of the excoriation shows areas of intact epidermis which abruptly undergo the characteristic changes of Paget's disease. This transformation consists of vacuolation of all the cells of the epidermis with a relative widening and slight dipping down of the interpapillary bodies, and an infiltration of leucocytes, plasma cells and the formation of many new blood-vessels in the corium. In many areas the epidermis has disappeared, so that the granulation tissue described, covered with a narrow zone of necrotic tissue, is exposed. The zone of inflammation is more extensive than in most of the cases studied. It extends deeper into the underlying tissues and to a slight extent beneath the sound skin. The intense reaction is probably due to the extensive loss of epiderm. The epithelial proliferation is pronounced in the superficial ducts and in the acini. In both the ducts and acini solid plugs caused by this hyperplasia are encountered, but a breaking through of the elastic membrane surrounding the ducts does not appear until the ducts situated about 3 cm from the skin are examined. In this region a carcinomatous process becomes well marked and the fibrous stroma is invaded by atypical acini and irregular aggregations of rather large columnar cells containing large, deeply-staining nuclei and granular protoplasm. Active hyperplasia is indicated by the irregularity in size and shape of the cells and by the presence of numerous mitotic figures.

The case is characterized by the usual picture of Paget's disease which has produced destruction of the skin in some areas. The ducts are the seat of hyperplasia of the lining cells which has produced a definite picture of cancer in a region where the cells have broken through and invaded the stroma.

CASE VI—E. R., aged fifty-one, a patient of Dr. W. L. Rodman, gave the following history. Five years ago a stabbing pain was noted by the patient in the right breast. This has continued off and on ever since, and in January, 1913, she first observed a small scab. One year previously a reddening to the outside of the right nipple began and the scab followed in the site of the reddened area. There has never been any discharge from the nipple. Two years later the reddened area extended all the way around the nipple, which was slightly eroded and inverted (Fig. 3). The appearance of the breast and the clinical history in many respects suggested Paget's disease. The microscopic findings (1375), however, did not confirm this diagnosis but revealed, in sections made through the nipple, that the process consisted of an infiltration of atypical acini. These grew from below toward the surface and gradually involved the epiderm in which acini can be found (Fig. 13). The changes in the skin represent merely an ulceration secondary to an infiltrating carcinoma and bear no resemblance to the microscopic characteristics of Paget's disease.

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## ON EXCISION OF THE TONGUE\*

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THE purpose of this communication is to call attention to a method of excision of the tongue which may be described as a variant of Crespí and Bastianelli's modification of Langenbeck's operation. Crespí and Bastianelli's Method is not described, so far as I can ascertain, in any of the text-books or systems of surgery at present in use in this country. I have merely mentioned it in my own text-book, and it is also mentioned, without credit to its originators, in Johnson's *Operative Therapeutics*, recently published.

Systematic excision of the tongue goes back to the time of Roux, who is credited<sup>1</sup> with having adopted in 1836 temporary division of the mandible, and who in 1839 did preliminary ligation of the lingual artery, finding then that after dividing the frænum and the anterior pillar of the fauces he could draw the tongue far outside the buccal cavity, and was able to complete the excision of its left half with facility. The method of operation popularized by Whitehead (1881) is a further development of that adopted by Roux.

Sédillot (1844) and Syme (1858) thought to make access easier by temporary division of the symphysis menti, and Kocher has now adopted a slight modification of this operation as his "normal procedure," and prefers it to the lateral suprahyoid operation formerly known by his name. The great advantage which median section of the mandible presents over Whitehead's method is that it permits simultaneous excision of the floor of the mouth when this is necessary. But as the carcinoma usually is situated at the side of the tongue, and spreads toward the fauces and pharynx, this approach gives insufficient access to the seat of disease in the majority of cases, and is best suited to those rather unusual cases where the carcinoma invades the mucosa around the frænum linguæ and does not extend far backward. Moreover, the wound left after operation by Sedillot's or Syme's technic is very prone to infection. In most cases, therefore, it is less applicable than Langenbeck's method (1875), which consists in making an incision

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\* Read before the American Surgical Association, June 11, 1915.

<sup>1</sup> Demarquay makes this statement, and Verneuil refers to the "Roux-Sédillot Operation."



FIG. 1.—Skin incision for excision of the tongue





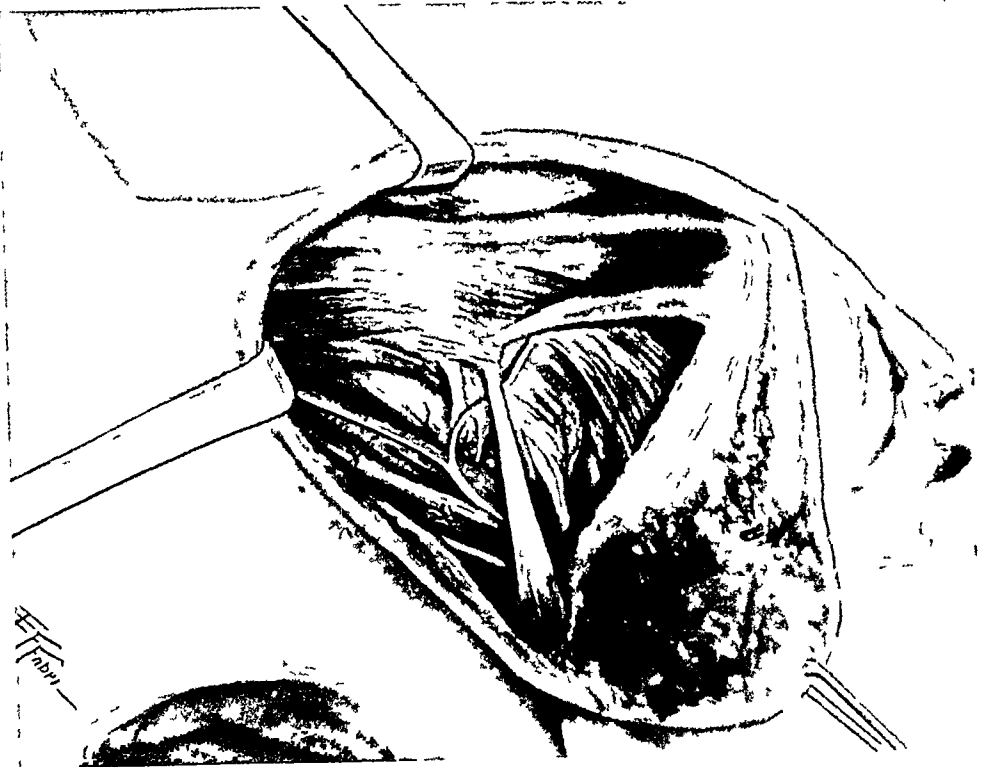


Fig 2 —The neck dissection has been completed, the cervical lymphatics and fat still attached to skin flap The neck wound is then tamponed with gauze



Fig 3 —The cheek has been turned aside exposing the tongue The left anterior pillar of the fauces has been divided and the scissors are now dividing that on the right



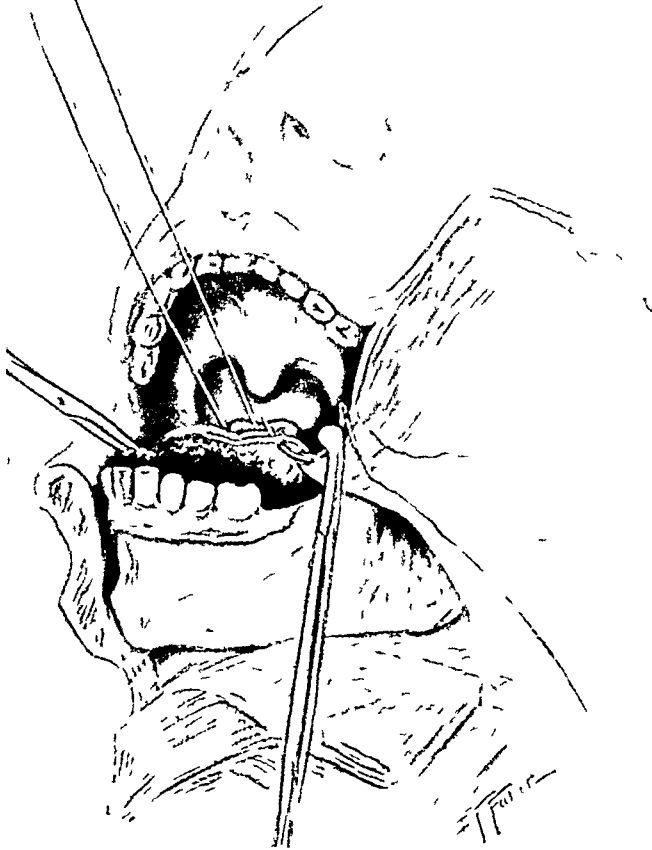


FIG 4—After removal of tongue floor of mouth is covered partially by suturing mucosa of cheek across alveolus to stump of tongue. A hæmostat is on the right lingual artery in the floor of the mouth



FIG 5—Skin incision sutured, drainage tube in place. Suture through platysma episthioides fold retained for first 24 to 36 hours

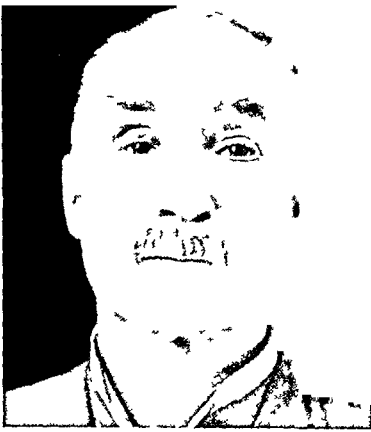


FIG 6—Excision of tongue eight months after operation

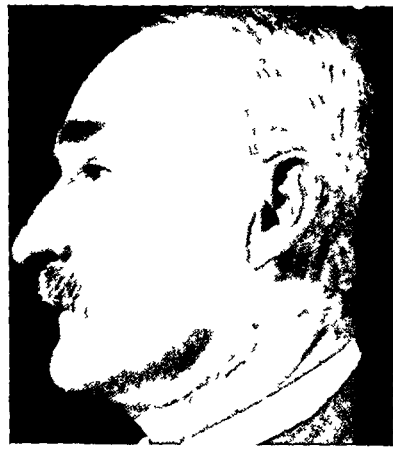


FIG 7—Excision of tongue, eight months after operation



A



B

FIG 9—A Four weeks after second operation (on right side of neck) B Four weeks after second operation two months after first operation (on left side of neck)



FIG 10—Two months after operation

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from the angle of the mouth downward to the level of the thyroid cartilage, with division of the mandible between the first and second molar teeth. The remarkably low immediate mortality which attended this operation in Volkmann's clinic appears to have passed from memory as completely as the operation has from practice. In 1889 Krause reported Volkmann's results with this operation from 1875 to 1888. There were 35 such operations in which temporary resection of the jaw was done, with 2 deaths, a mortality of 5.7 per cent, and there were 56 similar operations in which the disease was not so far advanced as to make division of the mandible necessary for complete extirpation, with not a single death from the operation, or, combining the two series of operations, there were 91 excisions of the tongue, with only 2 deaths, a mortality of 2.2 per cent, which compares favorably with much more modern statistics.

There are, however, two great objections to Langenbeck's method. The first is the unsightly scar, and the division of the branches of the facial nerve which the skin incision involves, the other, and a weightier objection, is that no adequate provision is made for extirpation of the involved lymph-nodes. In Crespi and Bastianelli's modification (1889) of Langenbeck's operation the former objection is absent, as the skin incision divides the lower lip in the midline and is continued outward along the body of the jaw to its angle and thence to the anterior border of the sternomastoid, but the second objection, the inadequacy of the exposure for extirpation of the lymphatics, still holds. They describe their method thus:

The soft parts are incised from the midline of the lower lip to the symphysis menti, and the incision is then prolonged outward along the lower border of the mandible to the anterior border of the sternomastoid. (In one case of invasion of the lateral wall of the pharynx, this incision was prolonged downward along the anterior border of the sternomastoid.)

This incision passes to bone through the lower lip and as far as the insertion of the masseter, and through the soft parts posteriorly as deep as necessary to allow the flap to be turned up well. This flap, composed of lower lip and cheek, is then turned upward. As the skin retracts downward, this exposes the submaxillary fossa, and the submaxillary salivary gland and lymph-nodes can now be extirpated, and the lingual and facial arteries and their veins ligated. By virtue of the prolongation of the incision along the sternomastoid it is possible to expose the great vessels and to draw them out of harm's way by a retractor.

Then the mandible is divided. The best point is in front of the next to last molar tooth. The mandible is sawed obliquely, as recommended by Langenbeck, from behind outward and forward. The fragments now separate by muscular tension, and are pulled widely asunder, securing "enormous" space. Then it remains to remove the tumor, according to the individual case.

The mandible is sutured, and the flap (lower lip and cheek) is replaced and accurately sutured, with adequate provision for drainage.

In a later publication (1902) Bastianelli further extended this procedure, as follows:

By the incision represented in Fig 8A, he sought methodically the ablation of the lymphatics, even if they were apparently healthy, in all cases of lingual cancer, if the strength of the patient permitted.

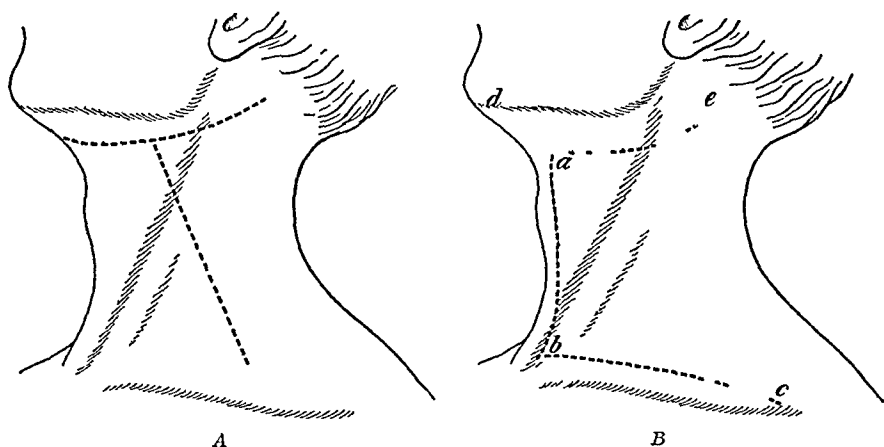


FIG 8—4 Bastianelli's incisions for extirpation of the cervical lymphatics  
B Incisions suggested by writer

*A Neck Part of the Operation*—1 First he makes a semilunar incision, with convexity below, from the symphysis menti along the midline to the hyoid bone, and then outward along its greater cornu, joining the anterior margin of the sternomastoid, and if necessary prolonged backward toward the nucha. The skin and connective tissue and platysma are incised, the external jugular vein is divided between two ligatures, and the flap is raised and fixed to the cheek by a suture. Then to clear the submental and submaxillary regions thoroughly the first step is to isolate and *ligate the external carotid artery* between the superior thyroid and lingual, or even just above the bifurcation. The venous branches must all be ligated doubly and cut between. Everything being cleared up to the mandible, the facial artery and

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vein are ligated here, and then the mass is removed. The branch of the facial nerve to the muscles of the lower lip is injured, but, as he points out, this is true of all operations.

2 Hæmostasis being complete, the wound is tamponed, and one proceeds to the removal of the deep upper carotid glands and inferior cervical glands. The former are often invaded, and if they make a tumor it may be possible to remove them through the incision already made, dissecting them from the sternomastoid and perhaps from the pharyngeal wall, taking care to avoid injury to the superior laryngeal nerve. If they do not make a tumor, and are little enlarged and scattered, or if apparently healthy, it is necessary to use an additional incision to expose them. This *second incision* is made perpendicular to the first which it leaves at the anterior border of the sternomastoid, about the level of the hyoid bone, and passes obliquely back and out to the supraclavicular fossa (Fig 8A). In fact this incision runs almost parallel to the omohyoid muscle and a little higher. It may be necessary to cut the sternomastoid across to facilitate exposure, turning its ends up and down and leaving its deep surface if necessary attached to the glandular mass. It may even be necessary to excise the muscle for a certain extent. He adopted section of the sternomastoid as a rule. The spinal accessory nerve is preserved. The dissection is difficult if there is no tumor mass, and numerous ligatures are required. The external jugular vein may be cut between two ligatures. The transverse scapular artery may be preserved. The cutaneous supraclavicular nerves are always cut, and the great vessels, the vagus and sympathetic nerves laid bare. The internal jugular vein may be resected with the glands if adherent. It is very important always to ligate or clamp above the tumor mass before cutting it out (to guard against recurrent bleeding). "The operation up to this stage always takes over one hour, good assistance, and patience."

If the other side of the neck is possibly involved, it is not operated on until the first side has healed. When the first side of the neck is completed, the wound is tamponed, and the second part of the operation (excision of the tongue) is undertaken immediately if the general condition of the patient permits, if not, it is postponed for eight to ten days. If a two-stage operation is necessary it is better to do the neck operation before that on the tongue, because, he says, after removal of the tongue there must elapse many days, sometimes *months*, before the patient can stand a second operation.

B *Tongue Part of the Operation*—1 If the lesion is limited to the anterior part of the tongue up to the pillar of the palate, or even if



extensive but the tongue still mobile, one succeeds well by the intra-buccal method

2 If the tumor, even if not diffuse, extends deeply toward the floor of the mouth, any intrabuccal operation is futile

(a) If the tumor is mobile, even in part, Bastianelli follows Kochei's lateral suprahyoid method

(b) If the tumor is diffuse, but not posteriorly, he adopts median division of the mandible

(c) If the tongue is fixed and the tumor extends posteriorly, he adopts systematically division of the mandible near the next to last molar (turning the cheek aside as in Cressi and Bastianelli's method already described)

At the end of the operation Bastianelli sutures the inside of the mouth as well as possible, and then packs the mouth with iodoform gauze. The skin is sutured only at its three extremities (1) in the midline, (2) at the posterior angle, and (3) below, thus leaving a great central opening which is packed with gauze to avoid secondary infection of the neck wound which he regards otherwise as inevitable

The slight modification of Cressi and Bastianelli's operation, to which I desire to call attention, was worked out on the cadaver in the Laboratory of Operative Surgery of the University of Pennsylvania. The operation includes removal of the upper cervical and submaxillary lymphatics on the side affected, and of the tongue, at the same sitting. Thus it is designed for cases where the disease is undoubtedly still in the operable stage. As a dissection of this magnitude, when thoroughly done, requires two hours for its performance, very few patients will be in condition to endure a more extensive operation at one sitting. If a more extensive neck operation is required it will be proper in almost every case to divide the operation into two or more sittings. Whenever an operation for excision of the tongue is done in two or more stages, the surgeon should not neglect Bloodgood's sound advice to cauterize the floor of the mouth both from above and from below.

*Technic of the Operation*<sup>2</sup>—The patient being anesthetized<sup>3</sup> and placed in the head-high position, an incision is made from the point of the chin downward in the midline to the hyoid bone, and thence along the side of the neck

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<sup>2</sup> The figures illustrating the technic of the operation were drawn by Mr E. F. Faber from dissections by the writer in the Laboratory of Operative Surgery of the University of Pennsylvania

<sup>3</sup> Intratracheal insufflation of ether should be used, preceded by thirty minutes by a hypodermic injection of morphine sulphate (one-sixth of a grain) and atropin sulphate (one one-hundredth of a grain)

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affected, following the folds of the skin, well below the body of the mandible, to the mastoid (Fig 1) This incision passes only as deep as the platysma, and is at once undermined beyond the midline in the submental region, and downward toward the root of the neck When this undermining has been completed, a block dissection of the neck is commenced at the circumference of the area thus exposed That is to say, the submental region is cleared down to the muscles (digastrics, mylohyoids, sternohyoids) from the far side of the midline toward the diseased side of the neck, and the dissection extends upward from well below the bifurcation of the common carotid artery to the floor of the mouth As the dissection is carried from below upward the descendens hypoglossi nerve is spared if possible, but all venous branches and the superior thyroid, lingual, and facial arteries are doubly clamped, divided and ligated as they are encountered, thus ensuring the removal of all the lymphatics in one mass The hypoglossal nerve itself is preserved, as well as the spinal accessory, both of them should be clearly exposed The superior laryngeal nerve should also be preserved The dissection is then continued across the mylohyoid and around its posterior border into the floor of the mouth, removing the entire submaxillary salivary gland along with the rest of the cervical tissues The lower portion of the parotid gland is also cut away to ensure complete removal of lymphatics in this region The mucosa between the tongue and mandible is not divided at this time, but the entire mass which has been dissected free is turned up with the skin flap upon the patient's cheek (Fig 2) This mass is then dissected off the skin flap, the platysma being removed with the mass, and the facial artery being ligated on the body of the mandible, to prevent recurrent hemorrhage The large wound is then swabbed out with a two per cent alcoholic solution of iodine, and is covered with a hot, moist pack This terminates the first stage of the operation, which consumes about an hour

The *second stage* of the operation comprises the removal of the tongue A stout linen suture is passed through the tip of the tongue, to be used as a tractor, and a mouth-gag is inserted on the opposite side of the mouth The original skin incision is then continued upward from the point of the chin to the free border of the lip, dividing the lip in the midline The mucous membrane between the lip and mandible is then divided with scissors, outward until the ascending ramus of the mandible is reached The masseter is not cut The cheek is then turned aside This gives excellent access to the tongue Another stout line suture is now passed through the glosso-epiglottidean fold, and both this and the suture through the tip of the tongue are drawn taut Gauze is then packed loosely in the pharynx, around the intratracheal tube The surgeon next divides the frænum lingue with scissors, and continues the division of the mucous membrane of the floor of the mouth from this point backward to the anterior pillar of the fauces, first on the opposite, then on the diseased side The anterior pillars of the fauces are then divided on both sides, and the tongue is drawn well out of the mouth (Fig 3) The tongue is then severed half way across its base (at least 2 cm beyond the visible limits of the carcinoma) on the diseased side, and then from the tip of the tongue backward along the floor of the mouth, to the transverse section, also on the diseased side The bleeding up to this point will be trifling, as the lingual artery on this side has previously been tied at its origin in the neck (before the dorsalis lingue branch is given off) The tongue is now held in the mouth solely by the hyoglossus and genio-

hyoglossus muscles on the side opposite to that diseased, as these are cut from before backward, the spurting lingual artery of that side is caught in a hæmostat, and if the dorsalis linguæ also spurts it likewise is caught in the stump of the tongue, which is held up in good view by means of the suture previously passed through the glosso-epiglottidean fold. These clamped arteries are ligated. Molar teeth on the diseased side are then extracted and the corresponding alveolus is cleared of mucous membrane, if necessary the alveolus may be excised. This permits the mucosa on the buccal surface of the cheek to be drawn in as a flap and sutured across the denuded alveolus to the stump of the tongue (Fig 4), thus rendering a bucco-cervical fistula less likely. The remaining portion of the stump of the tongue is sutured as securely as is possible to the mucosa still remaining on the inner surface of the alveolus throughout its extent, and the mucosa of the vestibule of the mouth is sutured to that of the lower lip, from behind forward. A few buried sutures are used to attach the cheek to the body of the jaw, and the skin wound is accurately closed, with rubber tube drainage from below the floor of the mouth to the most dependent portion of the incision (Fig 5). The pharyngeal gauze and intratracheal tube are then removed, but the suture through the glosso-epiglottidean fold is allowed to remain for twenty-four hours or longer, until the patient regains the power of swallowing.

A man, aged fifty-nine years, was operated on by me, at the Episcopal Hospital, by the method detailed above on September 25, 1913, the carcinoma having been present for five months or more<sup>4</sup>. He was encouraged to swallow immediately after operation, and slept well the first night after swallowing a dose of paraldehyde. He was able to take liquid nourishment from the first attempt. On the third, fourth and fifth days after operation a little liquid food discharged through the neck wound in swallowing, but this did not recur. He left his bed on the sixth day, and walked out of the hospital on the twelfth day after operation.

The accompanying photographs (Figs 6 and 7), made eight months after operation, show the excellent cosmetic result. At present, one year and eight months after operation, there is no evidence of recurrence, and the patient is in excellent health.

*Excision of All the Cervical Lymphatics*—When removal of all the cervical lymphatics is contemplated it is advisable to do the excision of the tongue at a second operation, two or three weeks after the neck operation. I believe systematic excision of the sternomastoid and omohyoid muscles in one mass with the involved lymph-nodes facilitates the dissection and renders recurrence less likely. I venture to suggest the following skin incisions for such an operation (Fig 8).

The incision (*a-b*) begins at the hyoid *near* the midline, and passes straight downward to the suprasternal notch, it is continued thence along the clavicle to the acromion (*b-c*). The triangular flap thus outlined containing only the skin (not the platysma) is raised and the deep dissection is begun at the root of the neck, after section of the sternal and clavicular attachments of the

<sup>4</sup>This case was reported in ANNALS OF SURGERY, 1914, 1, 289

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sternomastoid When more room becomes necessary the incision is extended from *a* to *e*, and this large flap, *containing the skin only*, is reflected toward the trapezius as a base When in the further course of the dissection the submaxillary and submental regions are reached, and still more room is required, the incision from *a* to *d* is made, and the flap *dae* is turned up over the mandible In this manner free exposure of the entire side of the neck is secured from clavicle to floor of mouth, and all the diseased structures are removed in one mass, the sternomastoid being sectioned again close to the mastoid After thorough cauterization (black heat) of the floor of the mouth from beneath the jaw, the flaps are replaced and accurately sutured, with tube drainage at *a* and at *c*

I had some fear at first that the extensive skin flap *cab* might slough, but in the two instances in which I have employed this method (Figs 9 and 10) the flap seemed to act as an immense Wolfe skin graft, and the only sloughing which occurred (insignificant in extent) was at the point *a*

The object in making the incision *a-b* to one side of the midline is to provide for a similar incision a few weeks later on the other side of the neck, by leaving a small strip of skin in the midline between the two longitudinal incisions, better nutrition is assured the flap on the second side of the neck than if this were to be formed by cutting along the cicatrix of the first operation As the flaps are well undermined in the submental region at each operation, no lymph-nodes here can escape removal

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## CONSERVATIVE OPERATIONS IN CYSTS OF THE BREAST\*

BY FRANK E BUNTS, M D  
OF CLEVELAND, OHIO

At the last meeting of this Association the surgical treatment of cysts of the breast received somewhat extended consideration both in the splendid paper presented by Drs Greenough and Simmons, and in the valuable discussion which that paper evoked. I must confess that the general trend of opinion expressed at that time somewhat startled me, as it was apparently so much at variance with the method which I had ordinarily pursued.

In general, I think, the impression obtained was that since a certain number, variously estimated by different writers, of cases of cysts of the breast were followed by carcinoma, and since women were becoming more keenly alive to the importance of all breast tumors and of their prospective relation to carcinoma, and therefore more willing to submit to extensive operations, the truly conservative treatment was amputation of the entire breast and possibly removal of the axillary contents at the same time.

It is not my purpose to go into a consideration of the various types of cysts of the breast, for it is difficult and often impossible to differentiate them before operation, and even afterwards, in some cases. The position taken by most, was that it was a dangerous matter to simply remove a cyst and then remove the entire breast subsequently if the growth proved upon pathologic examination to be malignant, and therefore the radical operation became the truly conservative one.

I am not aware that it has as yet been definitely established that the cyst is the cause of the cancer, but rather that cancer is present in a certain number of cases in which a cyst has developed. Just as chronic mastitis and the changes in the breast due to non-functioning seem to predispose in a certain number of cases to carcinoma, so do we find that they predispose also to the development of cystic mastitis. We know, too, that a very considerable number of breasts will develop carcinoma without any predisposing cause which we have thus far been able to establish.

It was with these thoughts in mind, and a feeling that the sanction of this Association to the doctrine that cysts of the breast demanded total amputation was fraught with unusual danger and hardship to women if it became the rule of action of those whose clinical experience

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\* Read before the American Surgical Association, June 10, 1915

## OPERATIONS IN CYSTS OF THE BREAST

would not allow of making exceptions, that I took up the study of the cases of this disease occurring in the practice of my associates, Dis Cille and Lower, and myself

Among a series of 648 operations upon the breast for every kind of disease, there were recorded 68 cases of cysts of the breast, nearly 10 per cent. These 68 represent all types of breast cysts without further classification. Many of them occurred among ward charity patients difficult or impossible to trace, so that we succeeded in getting but 55 replies from letters sent both to patients and attending physicians, and yet the significant fact was, that in not one of the 55 replies was there the history of the subsequent development of cancer. It is true that in 5 cases amputation of both breasts was performed and in 15 amputations of one breast, leaving 48 in which only a partial amputation or excision simply of the cyst was performed. In 13 of the amputations, the pathologic diagnosis of cystadenoma was reported, in 3 multiple cysts, and in 3 simple cysts, without any further explanation, and in 1 cystic papilloma. The same diagnoses were made in many of the cases in which only partial amputation or resection of the cysts was performed, so that there does not appear on the face of the records any special reason for the complete removal as contrasted with the partial removal. In other words, certain clinical symptoms not easily defined, and possibly not always well founded, have determined the more severe and more mutilating operation.

In a general way it has seemed that cases with multiple small cysts or with the symptoms of diffuse general mastitis without palpable cysts were the ones demanding most careful consideration with regard to the question of amputation, while those presenting single or even multiple well-defined cysts were the ones in which amputation was least frequent. Nevertheless it remains true, in my estimation, that each case demands its own consideration, and I believe that the results in this series, at least, justifies this conclusion.

The ages of these 20 cases of total amputation varied from twenty-four to fifty-two years, the average being forty-one years, while in the remaining cases in which only the excision of the cyst was done the ages varied from twenty to fifty-seven years, the average being slightly over thirty-nine years.

It is perhaps of interest to note the frequency of their occurrence with regard to age, in the decade between twenty and thirty, 10 cases were operated; between thirty and forty, 20 cases, and between forty and fifty, 28 cases, the remainder being above fifty or else the age not recorded.

Very little information can be gained from these figures except that more cases came to operation between forty and fifty years of age, a period commonly accepted as the cancer age, than at any other time, a period when the changes incident to a chronic mastitis may eventuate in carcinoma or cystoma, and it does not necessarily follow by any means that the carcinoma is developed because of the pre-existing cyst, since the other predisposing factors of carcinoma are most apt to be present at this time

The statements of patients regarding the duration of the lump or cyst are notoriously untrustworthy and in this series of cases the shortest time was one day and the longest eighteen years, and I still have under observation a patient with multiple cysts in both breasts in which operation was refused twenty years ago, and another in which there has been a sanious discharge from the nipple for over six years and yet no other present sign of malignancy exists after this lapse of time

It is not at all clear in my mind in looking over the record of these 68 cases that marriage or celibacy, child-bearing or non-child-bearing has much to do with the occurrence of cysts of the breast, thus, 48 were married, 18 single, and 2 no record, and of the 48 married patients 15 had children, 13 had not, and in 20 there were no records as to this fact

In considering the advisability or necessity of operation, it seems to me that we must first of all assume that every female breast is, potentially, a cancer-bearing organ and that their early removal would obviate the occurrence of one of the most dreaded of all diseases, but surely this could not be accepted as an indication for operation. It has been said that after the age of thirty years amputation is the conservative procedure. I confess I am unable to agree with this view. The average ages of two different groups of these cases were forty-one and thirty-nine years respectively, and 48 of them were between thirty and fifty years of age. It certainly would have been a needless sacrifice to have performed a complete operation in these cases. Even with the higher appreciation which many women now have of the dangers that attend the neglect of lumps in their breasts, we should hesitate to promulgate a mode of procedure sanctioned by their fears, but bitterly resented as a mortifying mutilation which they are compelled to accept because medical science has so ruled it. Such a mutilation is no light thing to a woman in the prime of life, though her fear of cancer of the breast may prompt her to ready sacrifice of it.

The final decision as to whether or not a complete operation should be performed should, in my estimation, be determined by the clinical and physical aspects of the tumor and of the breast in which it is found,

## OPERATIONS IN CYSTS OF THE BREAST

and no arbitrary age limit should be adopted as the determining factor. It is true that in some cases of partial resection of the breast after the manner of Warren's operation, carcinoma may subsequently develop, but so it may in any breast, and, until the relation between cysts and carcinoma is more definitely determined from an etiologic stand-point, it seems to me that in a large proportion of cases of cyst of the breast, the partial operation, consisting of the removal of the cyst with a considerable section of the breast tissue containing it, is the preferable operation, and that a carcinoma occurring in that breast subsequently should be dealt with in the same manner as if it were an entirely distinct disease.



# AMPUTATION OF THE BREAST BY A TRANSVERSE INCISION

BY FRANCIS T STEWART, M D

OF PHILADELPHIA

PROFESSOR OF CLINICAL SURGERY, JEFFERSON MEDICAL COLLEGE

THE operation described below embodies the principles laid down by Halstead, with the following The axilla is attacked first, in order to determine the extent of the lymphatic involvement and the feasibility of radical treatment (Gross), in order to secure, once for all, at their origin, the blood-vessels supplying the breast, thus minimizing hemorrhage, economizing time, and preventing shock (Meyer), in order to suppress lymphatic drainage as early as possible and prevent neoplastic dissemination (Gerster), and in order to leave the breast as a warm covering for the thorax until the final stage of the operation The incision permits free exposure, including the subscapular space, which is sometimes neglected, does not run on to the arm or through the axilla, in which situations a contracting scar may interfere with the functions of the arm or press on the blood-vessels and the nerves, and, with extensive undermining, can almost always be closed When primary closure cannot be obtained the raw surface is covered with pedunculated flaps from the abdomen and the back Owing to the situation of the incision a second opening is not needed for drainage, and the dressing of the wound is simplified The drain, when employed for lymphorrhœa, is removed at the end of two days, and never replaced Leaving the wound open and prolonged drainage mean infection and much fibrous tissue

An incision, skirting the upper margin of the breast, is made from a point on the edge of the sternum farthest from the growth and on a level with the nipple, to a point on the same level at the posterior axillary fold (Fig 1) Towels, which are not shown in the illustrations, are attached to the edges of the incision, so as to exclude completely the skin from the field of operation Parenthetically we may state that in order to avoid fatigue of the eyes and, especially in class work, to bring the operative field into greater relief, we employ, following the advice of Sherman, black, instead of white, sheets and towels for all operations The skin is undermined from the incision to the clavicle and the head of the humerus, and from the sternum to the posterior

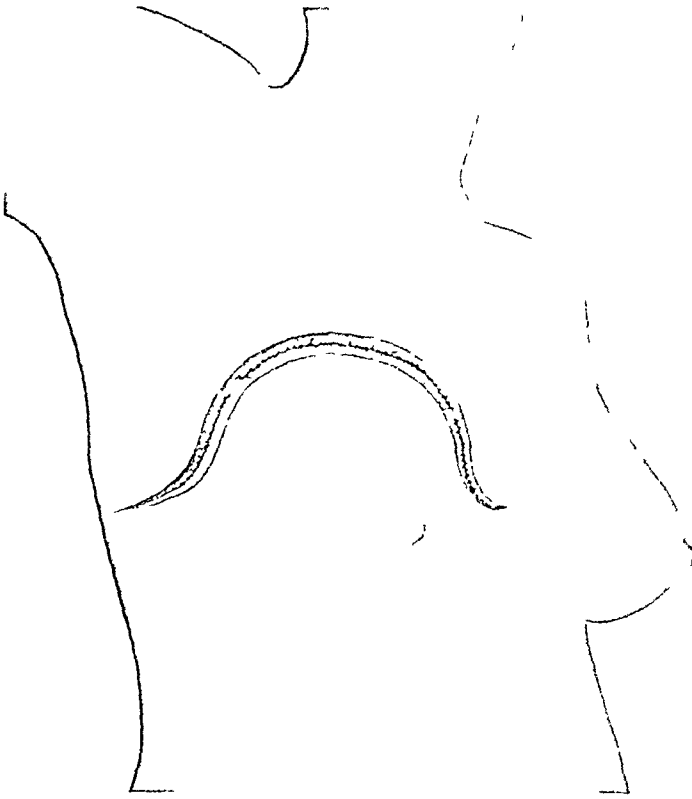


FIG 1 —Primary incision The towels which should be attached to the margins of the wound are not shown

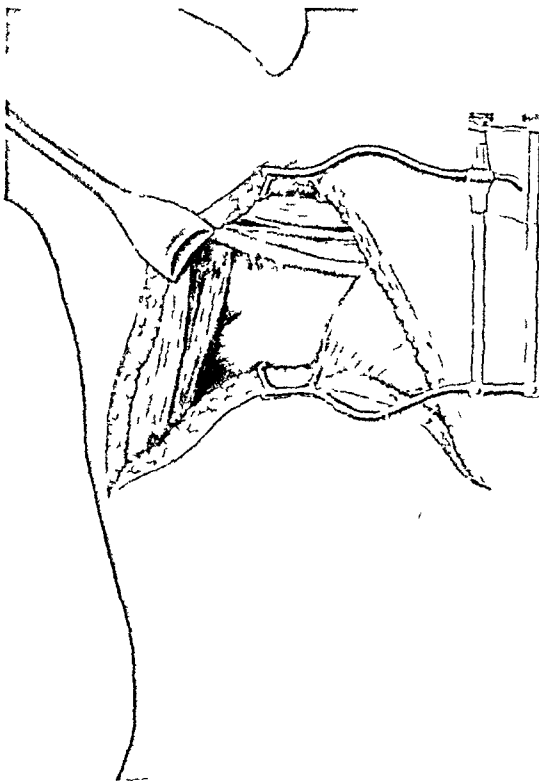


FIG 2 —Dissection of axilla

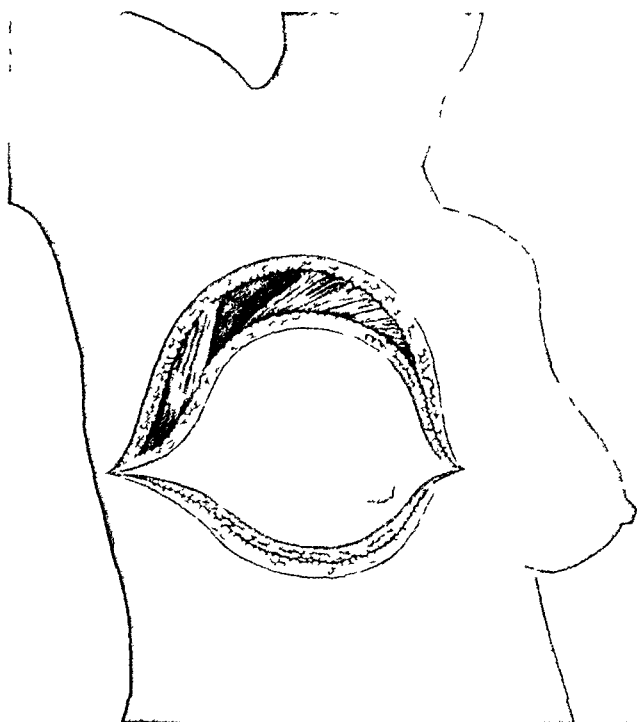


FIG 3 —The lower incision is made after evacuation of the avilla

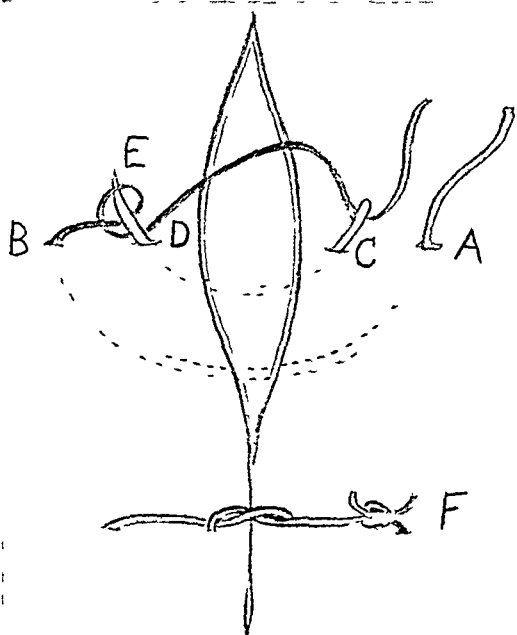


FIG 4 —Combined retention and coaptation suture. The needle is inserted a couple of inches from the edge of the wound (A) and brought out at a corresponding point on the opposite side (B). It is then reinserted close to the wound (C) and on emerging from a corresponding point on the opposite side (D) is passed through the loop E. When the suture is tied (F) the edges of the wound are held firmly together and inversion of the skin does not occur.

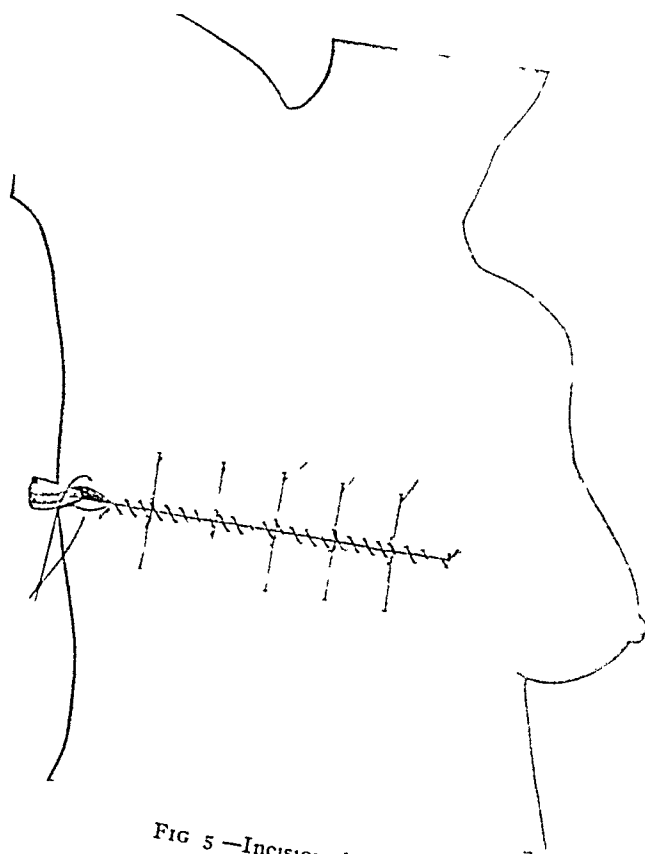


FIG 5 —Incision closed



axillary fold The clavicular is separated from the costal portion of the pectoralis major, and the tendon of the latter severed close to the humerus The costocoracoid membrane is divided, and the pectoralis minor cut at its point of insertion With a self-retaining retractor of the Balfour type, and a smaller retractor held by an assistant, the entire axilla is exposed for evacuation (Fig 2), which progresses from above and within downward and outward, as in the Meyer operation The vessels supplying the breast are divided between ligatures The subscapular vessels are tied at each end, and, with the environing areolar tissue, pushed toward the median line, thus laying bare the latissimus dorsi, teres major, subscapularis, and serratus magnus The ends of the original incision are joined by a cut which skirts the inferior margin of the breast (Fig 3), and the skin undermined to the level of the lowest portion of the costal arch, or even lower Through this incision one may remove, as suggested by Handley, the deep fascia over the upper portion of the abdominal muscles, we have not adopted this procedure as a routine measure Next the breast is turned toward the opposite side of the body, the origin of the pectoralis minor cut, the perforating vessels seized before division, and the mass removed by severing the costal origin of the pectoralis major The wound is irrigated with hot salt solution, and closed with several combined retention and coaptation sutures of silkworm gut (Fig 4), and a continuous suture of celluloid thread, except at the axillary end, where one suture is left untied, to provide an exit for a gauze diam (Fig 5), which is removed in 48 hours and the suture tied

The arm is not bandaged, and the patient is allowed to put it into any position she desires Œdema of the arm immediately following operation we regard as a favorable sign, it indicates that the operation has been thorough, that all the lymphatic structures in the axilla have been removed, and the lymphatic drainage of the arm completely interrupted It usually disappears in from two to four months, but may last longer, and indeed be permanent Œdema appearing after an interval is due to pressure on the axillary vein by a cicatrix, by a recurrent growth, to a neoplastic invasion of the vein, to venous thrombosis, to a tardy lymphangitis or lymphthrombosis, hence is not always, as is sometimes thought, a premonitory sign of early dissolution

We have employed the method described above during the past five years, in 40 cases, and our colleague, Professor John H Gibbon, has, during the past four years, used the same procedure in 47 cases, making in all 87 amputations of the breast by the transverse incision

# NON-CALCULOUS OBSTRUCTION OF THE UPPER URETER\*

By CHARLES H. PECK, M.D.

OF NEW YORK

SURGEON TO THE ROOSEVELT HOSPITAL

IN September, 1906, I was confronted by a surgical problem which caused me much anxiety and which I failed to solve in a satisfactory manner. A woman fifty-four years of age came under my care with complete obstructive anuria of 48 hours' duration. Her left kidney had been removed seven months before for sepsis, following two previous operations for nephrolithiasis. Several attacks of partial obstruction of the right ureter had been relieved spontaneously in the interval, the attack in which I first saw her being the first absolute closure.

Emergency nephrotomy was followed three weeks later by an attempt to relieve the non-calculous valvular obstruction at the junction of pelvis and ureter by a plastic operation similar in type to the Finney pyloroplasty. After much effort and many subsequent attempts to pass ureteral catheters both from below and above, failure had to be acknowledged, and permanent lumbar drainage established, with proper apparatus for collecting the urine. The patient lived in comparative comfort until October 23, 1907, when she died following an operation for infection of the nasal sinuses, performed by another surgeon.

In February, 1910, a man thirty-nine years of age presented himself with a history of frequent attacks of right renal pain, dating back for about a year. Cystoscopy showed diminished right renal function, and radiographs were negative.

Operation showed a tense hydronephrosis of moderate size, with a high ureteral implantation and hooding of the posterior part of the pelvis in such a way as to cause valvular obstruction of the upper ureter. The obstruction was complete at the time of the operation and pressure failed to force urine from the pelvis into the ureter. Nephrotomy showed much thinning of the cortex with dilatation of the calyces, and a single calculus, the size of a pea, which was not at that time lodged at the entrance to the ureter, but was free in the sac. After collapse of the sac a good sized spiral metal ureteral probe was passed through the opening in the cortex, into the ureter and on to the bladder without meeting obstruction. A diamond-shaped segment of the re-

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\* Read before the American Surgical Association, June 11, 1915

dundant posterior wall of the pelvis was then excised, and, after inspecting the ureteral orifice, the defect was carefully sutured with two tiers of fine chromicized catgut in such a way as to secure normal relations at the pelvi-ureteral junction

Remembering my unfortunate experience with the former case it occurred to me that it might be well to leave the ureteral probe in position to act as a sort of splint, and to guard against kinking or angulation at the pelvi-ureteral junction while the replaced kidney was becoming fixed in its new position. The metal probe was therefore again passed through the opening in the cortex of the bladder, with a small tube drain alongside, reaching the kidney pelvis, a mattress suture of catgut through the kidney substance was placed about both and tied just tight enough to control hemorrhage, the kidney was replaced and the wound closed to the exit of the drain and probe, the latter being bent to the surface of the body and secured with adhesive straps

The probe was removed at the end of twenty-four hours, the tube drain at the end of four days, and the patient made an uneventful recovery. Post-operative pain while the probe was in place was perhaps somewhat greater than after an ordinary nephrotomy, but not excessive, and no apparent harm of any sort was caused by the presence of the probe

Subsequent cystoscopy, nine weeks later, showed secretion from the right ureter normal in amount, appearance and rate. The patient has remained well, with no return of symptoms, for more than five years. The right kidney, damaged as it was by over-distention, was saved as a functioning organ

The outcome of this case encouraged me to apply the principle of "splinting the ureter" to subsequent cases, and I have performed the operation fourteen times

Four of the cases (including the one reported) had distinct hooding of the pelvis with complete valvular closure at the pelvi-ureteral junction, two with a small calculus and two without. In three cases diamond-shaped segments of the posterior pelvic wall were excised, the defect being sutured in such a way as to bring the ureteral implantation into correct relation with the pelvis, and in one the pelvis was plicated without excision of a segment to produce the same effect. In all except the first case ordinary ureteral catheters of large size were used as splints instead of a metal probe

Late reports on these four cases show them to be in good condition, without recurrence of symptoms, for five years four months, three



years five months, three years seven months, and one year five months, respectively

Two cases had mobile kidneys with marked dilatation of the pelvis without definite hooding or valvular obstruction. In these the obstruction was probably due to kinking of the upper ureter dependent on the mobility of the kidney. Insertion of the ureteral splint and nephropexy was the procedure adopted in these cases without resection or plication of the wall of the pelvis.

Two cases had definite cicatricial stricture of the ureter 1 inch and  $1\frac{1}{2}$  inches, respectively, from the upper end, one of them having a single small stone and the other 26 very minute calculi, one of the latter impacted just above the stricture. These strictures were carefully dilated with metal probes before the ureteral catheter was left in place.

One case had kinking and obstruction of the upper ureter following a nephrotomy performed for calculus four years previously, due to post-operative adhesions.

One case had an S-shaped kink in the ureter without much dilatation of the pelvis, but with intermittent attacks of pain of an ureteral type.

Two cases had chronic pyelitis of a mild degree, with attacks of pain suggesting intermittent obstruction, dating back two and ten years, respectively. In neither case was there much dilatation of the pelvis, nor could the presence of an actual obstruction be demonstrated. Both of these cases were drained to the pelvis of the kidney in addition to having the ureteral splint placed. In one case the splint was placed at a secondary operation following excision of a tumor of the bladder which involved the right ureteral orifice, for development of kidney pain and ureteral obstruction, the idea being to keep the lower ureteral orifice patent during healing of the bladder wound. For several reasons I doubt the wisdom of this procedure, and do not advocate it, although it seemed to be followed by at least temporary relief in the case referred to.

I have received reports from all the fourteen cases cited, and all have remained well since the operation, and permanently relieved of their former symptoms. None have required secondary operations. The cases have seemed worthy of report, to call attention to the use of this method of splinting the ureter by leaving a firm ureteral catheter in place for a few days after operation, thus guarding against kinking or angulation of the ureter or pelvi-ureteral junction while kidney and

ureter are becoming fixed in their new position after operation. I believe that in a number of cases of moderate hydronephrosis due to obstruction of the upper ureter, the use of this method, combined with a plastic operation on the pelvis of the kidney, with nephropexy for movable kidney, relief of constricting bands or vessels and so forth, will result in saving a functioning organ in some cases which might otherwise come to secondary nephrectomy.

## CORRESPONDENCE

### DR DEPAGE'S LETTER OF APPRECIATION TO AMERICAN SURGEONS

MY DEAR COLLEAGUES

I have received from a large number of you, and notably from the Committees which you have formed, the most touching tributes of sympathy and of condolence for the catastrophe of the Lusitania in which my wife lost her life

These tributes are so numerous and so unanimous, that I wish to express to you publicly my appreciation of them I address myself to you, my dear colleagues, as the authorized representatives of the humanitarian sentiments which so honor the great American Nation

You all know, as I wrote to you when my wife left for America, for what purpose she accepted the mission which the Red Cross confided to her In the presence of the unexampled miseries of which we have been the prey, she had resolved to solicit your fraternal assistance You gave her that largely, I should say "joyously," if the word could be pronounced in these times

The letters my wife wrote to me in the course of her mission told me how you worked for her and revealed to me the extent and generosity of your projects for our wounded Your hearts were open to our appeal, your Country did not wait to come to our assistance Powerful America wished to take under her protection our little people, tortured but always valiant

My great sorrow does not permit me to reply as I wish I might to each one of you Only to-day have I been able to measure—thanks to the letter of your compatriot, Dr Houghton—the extent of the gratitude I owe, to him first for having risked his life in trying to save that of my wife, and after that to you all for your devoted help in our common work

Under the strain of my emotion, the sentiment of thankfulness is the only one to which at this moment I am able to give expression Permit me to do so with all my heart

ANTOINE DEPAGE

June 25, 1915

# ANNALS *of* SURGERY

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## THE PHENOMENA OF ACIDOSIS AND ITS DOMINATING INFLUENCE IN SURGERY\*

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LIFE is incompatible with acidity, for not only animal but plant life as well demands for its continuance an alkaline or at least a neutral medium. When soil becomes acid it must be "fertilized" by the addition of alkalies, or it becomes sterile. Water plants cannot grow in acidulated water, and if the alkalinity of the blood in animals be even slightly diminished life ceases.

It is, however, by the breaking down of alkalies and bases that energy is produced for muscular action and heat, that is, for the phenomena of life itself, and the breaking down of alkalies and bases is invariably attended by the formation of acid by-products. If the soil, the sea and the blood must be alkaline in order to support life, and if the activities of life are constantly producing acids, by what means are the acid by-products of energy transformation neutralized? The acidity of the soil is removed by man by the addition of fertilizing mixtures, the plants rid themselves of their acid by-products by diffusion into the soil through their roots, for man, however, a special mechanism of neutralization and elimination is required.

On *a priori* grounds one would expect that part of the mechanism evolved in the human body for the elimination of acids would be adapted to eliminate the gaseous acids and another to eliminate the acids in solution.

The elimination of gaseous acid,  $\text{CO}_2$ , is obviously principally accomplished by the lungs. The maximum ventilation of the lungs is attained by rapid and deep respiration, by wide dilatation of the nostrils, the bronchioles and the air vesicles. Dilatation of the *alæ nasi*, of the bronchioles and of the air vesicles is governed by adrenin, while the rate and amplitude of respiration is under the control of the respiratory

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\*Read before American Surgical Association, June 11, 1915

centre in the medulla An increase of  $\text{CO}_2$  in the body must therefore cause an increased output of adrenin, and must increase the activity of the respiratory centre

Magnus, Elliott, Cannon and myself have shown that exertion, emotion, injury, infection, auto-intoxication, Graves' disease, strychnine convulsions, injections of indol and skatol, of amino-acids, of foreign proteins, of placental extract—in fact all the activators of the mechanism for energy transformation, cause an increased output of adrenin We have shown also that all these activators cause increased acid by-products, both gaseous and in solution The adrenals are controlled by the brain, and when the connection between the brain and the adrenals is severed, or when the function of the brain is depressed or suspended by morphia, then activation of the adrenals causes no increased output of adrenin Physiologists are now agreed that the H-ion concentration of the blood governs the respiratory centre

These facts show that the mechanism for the elimination of the gaseous part of the acid by-products of energy transformation—metabolism—consists of the brain, the adrenals and the lungs That is, the presence of carbon dioxide in the blood stimulates the centres of the brain which govern the rate and the amplitude of respiration and that which governs the output of adrenin Therefore, the injection of  $\text{CO}_2$  in a normal individual should cause increased adrenin output and increased respiration—and by experiment we have proved that it does so The injection of carbon dioxide alone causes no other symptoms

It is of immense significance that the vital function of the respiratory centre is controlled by the H-ion concentration of the blood The mere fact that the H-ion concentration rather than oxygen controls the respiratory centre shows, in fact, that the life of animals is more endangered by increased acidity than by decreased supply of oxygen

The final points of exit from the body for the acid by-products which are in solution in different body fluids are the kidney tubules and the sweat-glands The acid by-products of energy transformation when first formed, however, are not in a chemical form suitable for elimination by the kidneys or the skin, but must first be transformed into harmless salts, such as phosphates, sulphates, chlorides, urea, creatin, and creatinin In these forms acids may be eliminated without harming the kidneys

It is necessary, therefore, to discover where the chemical substance or substances which transform the harmful acid by-products of metabolism into harmless acid salts are stored, what mechanism regulates

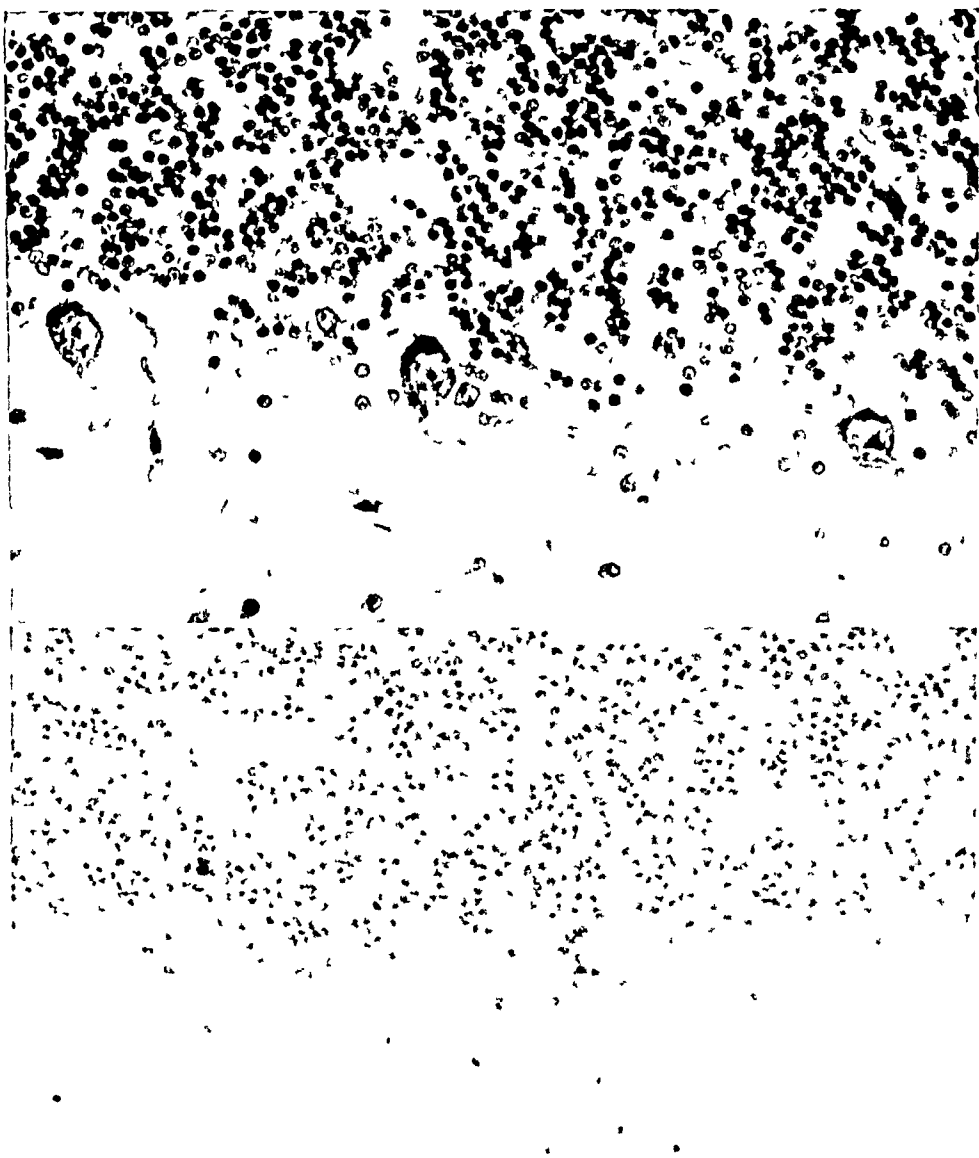


FIG. 1 —A, Section of human cerebellum—normal ( $\times 310$ ). B, Section of human cerebellum showing effect of acidosis ( $\times 310$ ). There are no active cells present, but faint traces of the Purkinje cells are visible

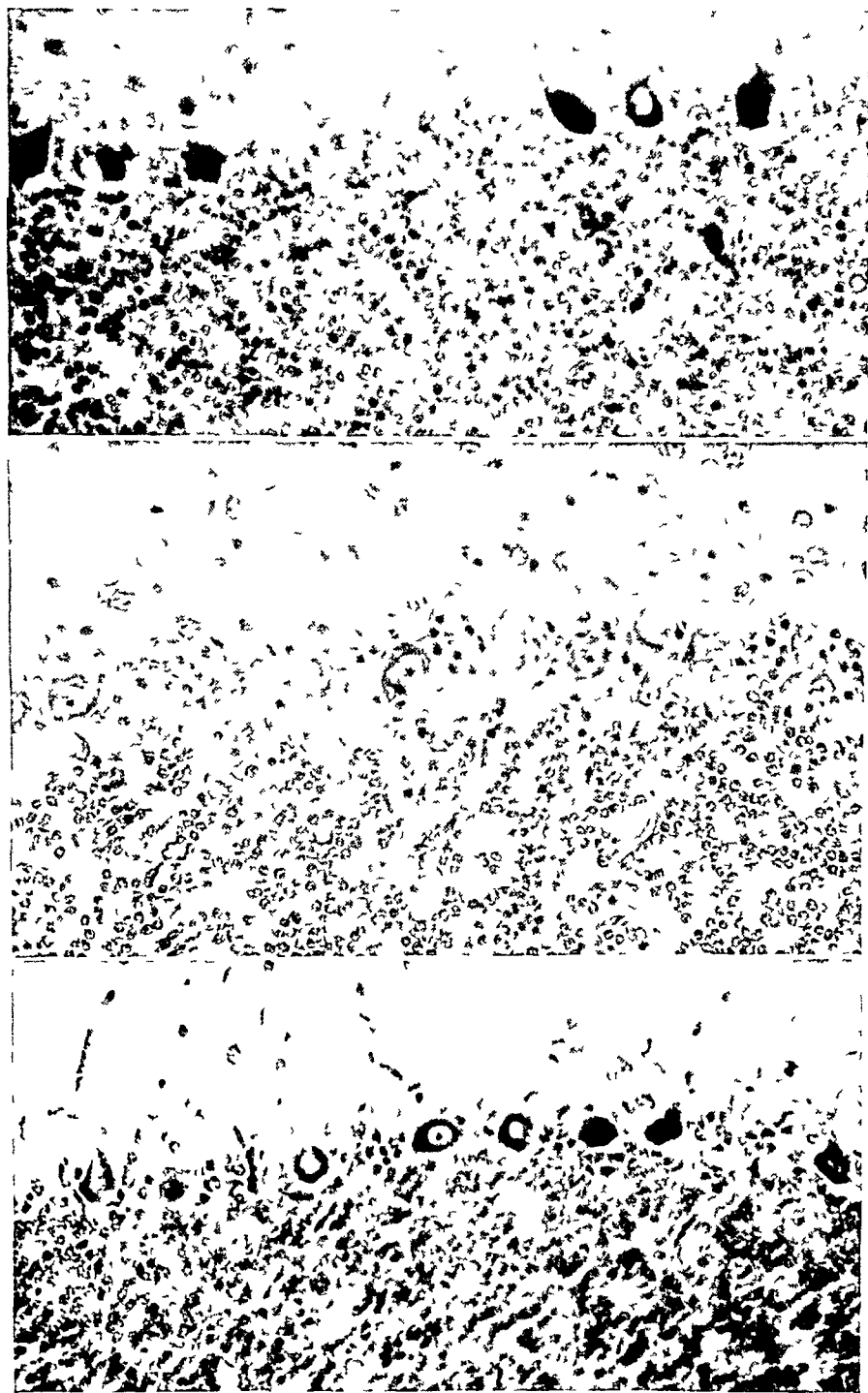


FIG 2 —A, Section of cerebellum of cat—normal ( $\times 310$ ) B Section of cerebellum of cat showing effect of injection of acid sodium phosphate ( $\times 310$ ) Compare the destructive effect of the acid with the protective effect of the alkali in C C, Section of cerebellum of cat showing effect of injections of sodium bicarbonate ( $\times 310$ )

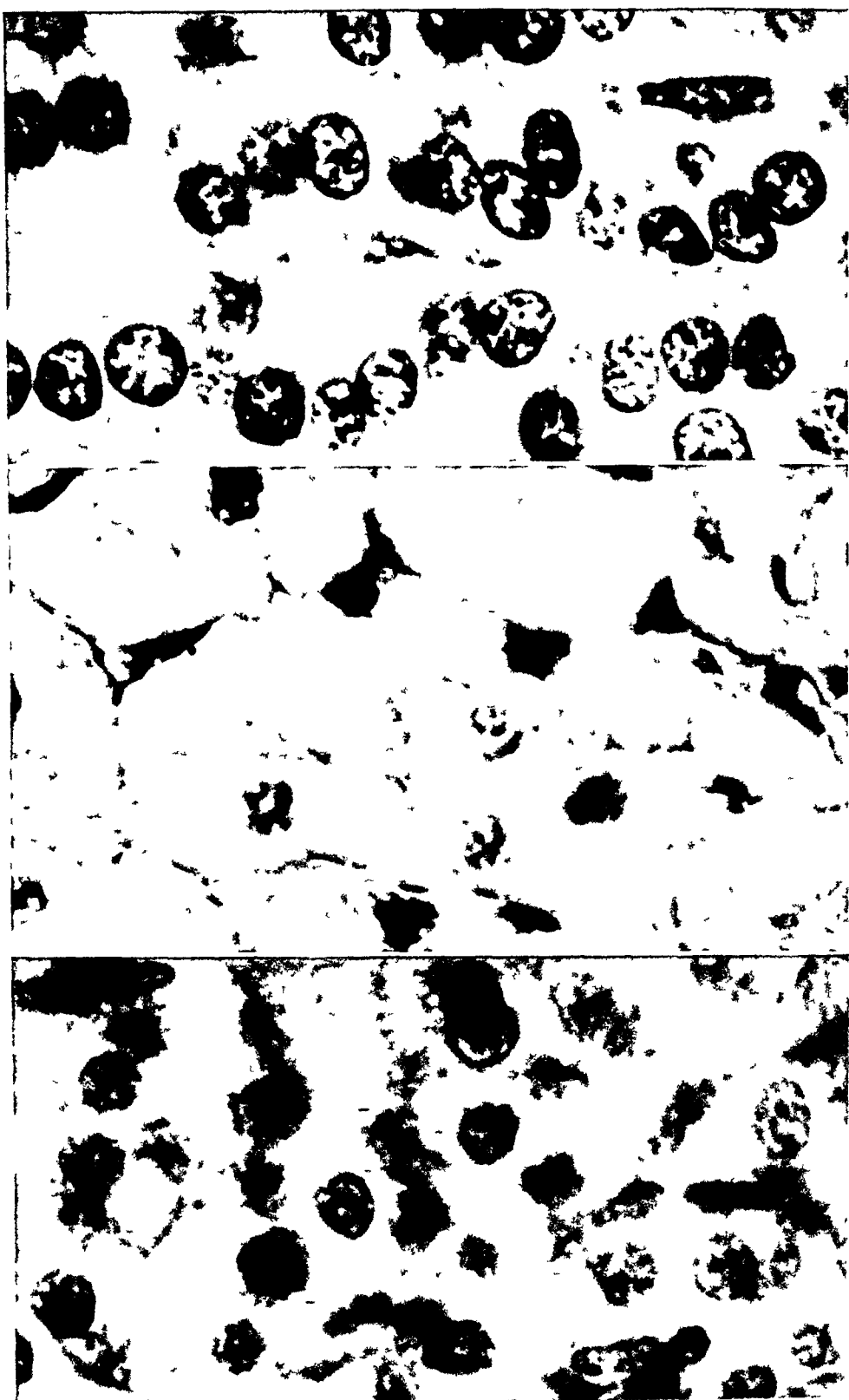


Fig. 3—A Section of normal adrenal of cat ( $\times 1640$ ). B Section of adrenal of cat showing effect of injection of acid sodium phosphate ( $\times 1640$ ). Note the disappearance of cell substance, the misshapen cells and eccentric nuclei. C Section of adrenal of cat showing effect of injection of sodium bicarbonate ( $\times 1640$ ). Compare the protective effect of the alkali with the destructive effect of the acid in B.





FIG. 4.—*A* Section of liver of cat—normal ( $\times 1640$ ). *B* Section of liver of cat showing effect of injections of acid sodium phosphate ( $\times 1640$ ). Note the general disappearance of cell substance and the vacuolated spaces. *C* Section of liver of cat showing effect of injections of sodium bicarbonate ( $\times 1640$ ). Note the protective effect of the alkali as compared with the destructive effect of the acid in *B*.

the supply of these substances, and whether the stimulus that activates the mechanism by which energy is transformed into muscular action simultaneously activates the mechanism by which the acid by-products resulting from energy transformation are neutralized or transformed

In my laboratory we have endeavored to answer these questions both by chemical and by histologic studies. Examinations of all the organs and tissues of the body after the application of every kind of kinetic stimulus showed histologic changes—disappearance of chromatin and changes in the size and shape of the cells—in the brain, the adrenals and the liver, and in these organs only. Moreover, the injection of an acid, such as acid sodium phosphate or hydrochloric acid, caused identical lesions, while the injection of an alkali—sodium bicarbonate—caused no histologic changes in the brain, the adrenals and the liver excepting to increase their stainability. Chemical studies showed a diminished percentage of glycogen in the muscles after the application of kinetic stimuli and consistent changes in the iodine content of the thyroid and of the glycogen content of the liver as well. Our chemical studies showed further that all the fluids in the body excepting the urine are alkaline and that the blood, the spinal fluid and the bile are persistently alkaline, and that the *potential alkalinity* of each is great, that is, that each has a high power of acid neutralization.

For the further identification of the organs governing acid neutralization studies of the H-ion concentration of the blood were made after the excision of different organs. The excision of the pancreas, of the spleen, of the thymus, of the thyroid, of the testicles, of the ovaries, of portions of the intestines, of the stomach and of the brain caused no change in the H-ion concentration of the blood, but the excision of the adrenals or of the liver was followed by increased H-ion concentration before death.

That is, in from four to eighteen hours after excision of the adrenals the alkalinity of the blood began to decrease, and coincidentally with this decrease in alkalinity began the rapid decline of the animal. Excision of the liver was followed by death in from a few to sixteen hours, and just before death the H-ion concentration of the blood rapidly increased. Histologic studies of the organs of these animals showed, in the case of the animals which had undergone adrenalectomy, a marked deterioration of the cells of the brain and the liver, and in the animals whose livers had been removed the brain and the adrenals showed extensive histologic changes.

All of these studies determine that the brain, the adrenals, the liver, the thyroid and the muscles together play important parts in energy

transformation, and that at least three of these organs, the brain, the adrenals and the liver, are especially concerned also in the neutralization of the acids resulting from energy transformation

What is the function of the brain in acid neutralization? The evidence already given suggests that its part is to govern the mechanism by whose action the actual neutralization is accomplished. The following experimental observations further establish this fact. When the H-ion concentration of the blood of an animal had been increased to the point of actual acidity even—by emotion, exertion, or anæsthesia—and the animal was then deeply morphinized, it was found that the blood did not return to its normal alkalinity, that is, the body had lost the power to neutralize acidity. The clinic also has confirmed the fact that heavy morphinization hinders or even inhibits the neutralization of increased acidity caused by anæsthesia.

In addition a decapitated animal in which the H-ion concentration had been increased by anæsthesia or by strychnine convulsions showed but slight power of overcoming the acidity.

We conclude, therefore, that the brain performs a dual kinetic function—its driving power is the principal cause of the transformation of energy, and it has also evolved within itself a mechanism for the neutralization of the acid products of energy transformation.

In addition to the active functions of the brain, the adrenals and the liver in acid neutralization, the body fluids have an inherent form of neutralization independent of the brain.

If after excision of the brain the H-ion concentration of the blood is increased and adrenin administered, the neutralizing power of the body will be increased. If the liver as well as the brain be removed, however, the neutralizing power of adrenin will be lost.

If our conclusions be well founded, they provide us with the key to the causation of certain conditions and to the interpretation of certain clinical phenomena. For example, if in a certain case there is shown a continuous increase of acid by-products for the neutralization of which an unusual amount of alkali is required, then we may presume that the liver, the adrenals and the brain are undergoing abnormal changes, and that unless the acid condition be altered, these structural changes in the brain, the adrenals and the liver will become permanent and certain of the chronic diseases will result.

For the practical application of this study in my laboratory we are now measuring the acidity of the urine, blood, cerebrospinal fluid and bile by means of indicators—using with some modifications the methods of Sorensen, Henderson and others. In the case of urine and cerebro-

spinal fluid the indicators may be directly applied—the method being made applicable to blood by rapid dialysis by Rowntree's method

We employ two indicators (1) sodium alizarin sulphonate (2 per cent solution) and (2) phenolsulphonephthalein (0.6 per cent solution). This gives a wide range of H-ion concentrations varying from  $P_H = 8.7$  on the alkaline side to  $P_H = 4.57$  at the acid end of the scale, the neutral point being  $P_H = 7.0$

(It is customary to express H-ion concentrations in the way suggested by Sorensen, by the logarithm of the H-ion normal with the negative sign omitted—this being indicated by the symbol  $P_H$ .)

For making up the scale of standard solutions four stock solutions of known H-ion concentration are prepared

(a) Sodium acetate	27.2 gms per litre
(b) Acetic acid	27.2 gms per litre
(c) Disodium phosphate	17.8 gms per litre
(d) Monopotassium phosphate	13.6 gms per litre

To make up the standard solutions from which the color scale is made, these stock solutions are mixed in varying proportions to yield solutions of the desired H-ion concentrations. For example

20 c.c. stock solution (a) + 30 c.c. stock solution (b)  
+ 250 c.c. distilled water = A solution,  $P_H = 4.57$

The scale is made up by placing about 5 c.c. of each of the standard solutions plus one drop of each of the indicators in an equal number of hand-glass test-tubes of uniform size, then diluting the contents of each tube to about 15 c.c.

The H-ion concentration of any fluid may be quickly found, therefore, by placing about 2–3 c.c. of that fluid in a clean test-tube, adding a drop of each of the indicators, diluting the contents to about 15 c.c. and finding the solution in the scale which most closely matches it in color. The known H-ion concentration of that solution will be the H-ion concentration required.

For the dialysis of blood and of turbid urine collodion membranes are made. The solution to be dialyzed is placed in one of these membranes which is then lowered into a short tube containing normal saline solution at body temperature. This is kept at  $37^\circ \text{C}$  for a few minutes, the dialysate poured off and the H-ion determination made after cooling to room temperature.

This in brief indicates the method by which we are securing new light upon clinical problems.

We can sometimes foresee an impending acidosis. We can check

up the results of operative procedures We can see the trend of a case in which a condition of mild acidosis already exists, and may discover means by which to ameliorate the physical changes which are caused by or are incident to the presence in the system of abnormal amounts of acid These observations explain also the reason for what has long proved an advantage in these cases—the use of sodium bicarbonate, and the ingestion of large quantities of water Just as the acid soil needs water, so does the acid animal body need water

Whenever there is increased acidity in the body there is thirst When one exercises he is thirsty, as he is also if he has a fever or is in emotional stress Anæsthesia is followed by thirst, and we have proved that anæsthesia always produces acidity Acidosis is accompanied by sweating Sweating is nature's attempt to aid the kidneys and the lungs in their effort to eliminate acids An increase in pulse-rate is another phenomenon of acidosis and we have already discussed the function of the increased respiratory rate caused by increased  $H^+$  ion concentration

We see, therefore, that the principal phenomena of many normal processes and of many disease processes are due to the activation of the mechanism in the body by which acids are eliminated

Consider, for instance, the phenomena of ordinary fever, or of infection of any kind The prominent characteristic clinical phenomena in any case are due to the effort of the body to maintain the normal alkalinity of the blood The same thing is true of exophthalmic goitre Indeed in fatal cases of this intensely kinetic disease the common cause of death is acidosis The so-called post-operative hyperthyroidism is chiefly acute acidosis

In the cycles of exophthalmic goitre there are periods of vomiting, of acid breath, of restlessness, of rapid heart action, and of rapid respiration—all characteristic phenomena of acidosis

The acidosis of surgical shock and of Graves' disease on the other hand is the result of the kinetic driving of the entire system to such an extent that an undue strain is put upon all the organs of elimination This is the explanation also of the acidosis which results from overwork or from excessive physical exertion For the same reason also great emotion may produce an acute acidosis As a result of the strain put upon all the organs of elimination by the general activations, some one—the weakest—may break under the strain and a chronic acidosis will result

Another interesting and significant fact, proved by experiments in collaboration with Dr M L Menten, is that nitrous oxide, ether, and

chloroform during their administration all produce increased acidity of the blood. In our experiments we have found out recently the additional fact that the acidity of the urine is increased markedly under ether and chloroform—less under nitrous oxide. This finding has a most important significance for the surgeon, as it explains why the administration of the anæsthetic to a starved patient with gastric or duodenal ulcer, for example, may cause death by precipitating the impending acidosis. That acidosis does impend in these cases is well known, and our experiments have shown an increased acidity of the urine of starving dogs.

In view of these observations and generalizations, imperfectly sketched as they have been, we may well conclude that in greater or less degree acidosis is present in every abnormal condition of the body whose origin can be traced to excessive kinetic activations from any cause, and that the maintenance of the normal potential alkalinity of the body is of vast clinical importance. The factors increasing acid by-products—emotion, operative trauma, inhalation anæsthesia, starvation, infection—should as far as possible be controlled by the surgeon. The *associated* operation minimizes these injuring factors, but the patient should also be protected in advance of operation by giving water, glucose, and sodium bicarbonate, and the post-operative state also may be improved and convalescence hastened by these measures.

# A REVIEW OF THE LITERATURE OF FRACTURES \*

BY THOMAS W HUNTINGTON, M D  
OF SAN FRANCISCO

THE task assigned to me has proven most difficult from the purely statistical stand-point

With few exceptions, surgeons have neglected to perfect their records upon the following essential points, viz exact description of initial lesion, period of hospital residence, time interval between injury and resumption of work, degree of permanent deformity and loss of function

As a rule, favorite methods of treatment have found justification when union has taken place and the patient has been discharged Later and most essential details are rarely available I am of the opinion that the real merit of various methods and policies must await final adjudication, until a very large number of fractures have been observed for a period of from one to three years This will involve an outlay of time and effort as will rarely be incurred by individuals, and such investigation can only be efficiently carried out by social service organizations which command the time of men specially qualified for critical analysis

Furthermore, we are confronted by this vital consideration, that in each individual fracture, its mechanism and primary status are widely variable factors as influencing end results, or determining the value of a particular method of treatment The designation "fracture of the humerus," "forearm," "femur," or "leg," in the tabulation of a series of fractures is vague and indeterminate, in the absence of full details as to the peculiar features of each fracture

Similar comment applies to the classification "open," "closed," "comminuted," and "joint fracture," and deductions from indiscriminate classification are inherently misleading and of little scientific value

"All surgeons," says John B Walker,<sup>1</sup> "must admit the necessity of collecting data for future guidance in giving the best prognosis and treatment But it is possible to make this material of value *only* by carefully classifying and correctly collecting large numbers of cases, so that we can find the normal average duration of disability which is our best guide for treatment in a given type of case In our previous attempts to do this, we have become more and more dissatisfied with

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\* Read before the American Surgical Association, June 9, 1915

present statistics, for our judgment tells us that the majority of statistics are incorrect ”

Dr Chas G Levison, of San Francisco, in a personal communication says “ After going over my fracture histories I am unable satisfactorily to furnish data as to hospital residence, period of convalescence and degree of impaired function This is usual in hospitals which have not developed the social service system ”

Since the foregoing was written, Dr Harold Brunn, of San Francisco, in a personal communication, makes the following confirmatory comment “ I have attempted to follow your scheme in the analysis of a series of 63 fractures occurring in the City and County Hospital of San Francisco, and I find this to be impossible without giving an erroneous impression of our statistics, for the following reasons

“ First, histories are frequently incomplete, and essential data are wanting Second, the class of cases we have dealt with are, frequently, old and arthritic, or suffering from a complication of diseases Third, our patients, usually, are without means or refuge, and their hospital residence is prolonged unduly and measured by their ability to perform manual labor after dismissal

“ I feel, also, that every fracture, even of the same part, varies so much in character, that conclusions of value cannot be deduced ”

It is an aphorism that nearly every fracture embodies a potential loss of function and deformity Consequently, it is fundamental that analyses of end results, as related to types of fracture or special methods of treatment, must reckon not only with the bone or bones involved, but with the peculiar mechanism of small groups of each type This involves a study of the following collateral data

(1) The personal equation of the patient, age, social and physical condition

(2) The bone lesion, whether single or multiple, relation to joint structures, direction of fracture lines, and coexisting comminutions

(3) Trauma of soft parts, skin muscles, blood-vessels and nerve trunks

(4) The special method used and, in operative cases, the fixation material employed

For the above reasons, after referring to various phases of fracture treatment as set forth by leading authorities, I shall, briefly, review the work upon which opinions are predicated

Revival of interest in this department of surgery, in recent years, has led to a keen appreciation of the tremendous importance of the subject Surgeons realize that conventional methods of whatever type



do not satisfy the exactions of the patient or the courts. Each step in the development of the subject has suggested new and interesting problems in the associated sciences, biology, mechanics, economics, and sociology. Each of these interests has challenged consideration, and each has stimulated human endeavor.

Mankind has learned to think in similar terms, and has arrived at a finer sense of proportion. Precision has become the genius of performance, and values are expressed not in vague generalities, but in equations. Indifferent and arbitrary standards are no longer accepted as a yardstick, nor do they serve as a refuge. "Bony union," once the surgeon's shibboleth, in the presence of obvious defects, such as discomfort, lowered efficiency or loss of function, is no longer an achievement. Briefly, clinical and sociological results must be closely correlated.

*The Bloodless Method in Fracture Treatment*—Conservatism, in this relation, has many earnest advocates in England and continental Europe, and orthopædic specialists, generally, adhere closely to this plan.

It finds its most conspicuous exponents in Robert Jones,<sup>2</sup> Bardenheuer,<sup>3</sup> and Lucas-Championniere,<sup>4</sup> but all agree that open operation, in selected cases, is imperative.

Robert Jones is strongly of the opinion that conservative technic, as followed in the past, should be radically revised with a marked improvement in end results. He challenges the non-operative results as shown by British Medical Association Commission, and dwells upon the fact that the frequent occurrence of mal-union, non-union, and deformities is without warrant or apology.

Referring to a statement in the British Medical Association report, that operative treatment of fractures is in its infancy, while conservative methods are well established, he rejoins sharply, that no method is to be regarded as "well established." Until end results are uniformly ideal, all methods must be subject to close scrutiny and final revision.

He believes that most surgeons err in sparing traction, or in employing it intermittently, and insists upon long-continued, uninterrupted pulley traction which alone is mechanically efficient. He refers to a case of fracture of the femur of four months' standing, with three inches overlapping, which was fully corrected by this procedure. He states, further, that reduction quite incomplete during primary anæsthesia may easily become complete within forty-eight hours under traction. In certain cases, delayed union is inevitable, but these are not to be classified as "ununited fractures."

Lucas-Championniere,<sup>4</sup> 1895, advocated conservatism and relies upon

mobilization and massage, as essential to success. He sets forth the following postulates

- (1) A certain amount of mobility conduces to repair
- (2) Absolute fixation is often disastrous, because of consequent atrophy of joint structures, tendons and muscles
- (3) The more promptly resort is had to movement and massage, the more rapid will be repair

Encircling splints or bandages are condemned. The significance of moderate shortening, as related to ultimate function, is minimized, and, in fractures involving joints, he pays more attention to function than to appearances.

I am of the opinion that this comment should be challenged, for, in my experience, good functional results in joint fractures are in direct ratio to anatomical reposition, which means normal contour.

It is not strange that the teaching of Lucas-Championnière has found few followers among American surgeons, who, in the main, believe that perfect anatomical and functional conditions are interdependent.

Hackenbusch<sup>5</sup> is unreserved in his commendation of Lucas-Championnière's method, though with definite modifications. He applies plaster-of-Paris circular bandages. Later, the splint is divided at seat of fracture, and by means of an external mechanism, traction is exerted forcibly and continuously. The patient is then allowed freedom of movement. He deplores the effect of bed-life upon the patient, during treatment.

P. Watson<sup>6</sup> (Edinburgh) approves of the ambulatory, massage method, but makes no reference to fractures of the femur. His results, as shown by radiograms, are to be commended, and loss of time compares favorably with cases treated by other methods.

Surgeons are generally familiar with the Bardenheuer method by the application of multiple traction. He calls special attention to the difficulties that are encountered in dealing with ankle-joint fractures, and adds that there is no joint fracture in which faulty treatment is so severely avenged. Referring to his results, covering a period of five years, he quotes two of his assistants to the end that Bardenheuer's results in lower leg fractures are ideal and fabulous.

To this he appends the statement that his results since the above report was made are equally good. He insists that his method is simple and easily acquired, but admits that it involves great painstaking, and can be best carried out in hospitals. He suggests, very wisely, that every hospital should maintain a fracture department under the care of trained specialists.

E Lexer,<sup>7</sup> heartily in sympathy with Bardenheuer, resents the modern tendency to frequent operation, believing that cases requiring operation will always remain limited in number. He adheres to no special method, but deals with each individual fracture as a separate entity. He warns against long-continued splint life as affecting future function.

F Steinmann,<sup>8</sup> in 1907, devised his method of direct traction by passing a nail through the distal fragment, to the protruding ends of which he attaches a stirrup by which a cord and pulley are enabled to develop traction at any angle or level.

The advantages of this appliance over adhesive plaster are obvious, particularly in fat subjects or when the fracture is near the distal end of the bone, as in the lower leg or ankle-joint. The danger of infection is its one fault, but with ordinary precautions this is not a serious obstacle.

P Ewald<sup>9</sup> and George Woolsey,<sup>10</sup> advocates of conservatism, have frequent resort to the Steinmann traction method and regard it as an invaluable accession to surgical technic.

Without doubt, much is yet to be learned concerning the conservative treatment of recent fractures. Past results have shown by far too many failures and in no sense furnish a criterion in the setting up of present day standards. Moreover, we must not ignore the fact that purely mechanical methods require a measure of enthusiasm, ingenuity, and special training, which are beyond the capabilities of the average surgeon. Time exactions upon patient and attendants are, also, a formidable consideration, and in many cases will determine the selection of other than the bloodless method.

The exponents of conservatism seem to ignore one very important consideration, viz. that, in doubtful cases, where early efforts at reposition are ineffectual, there will remain a doubt as to the ultimate loss of function and earning power thereby entailed, until many weeks or months have elapsed.

If, as will happen with greater or less frequency, the result proves unsatisfactory, a proposal to revise the work by a secondary operation will uniformly be accepted by the patient with hesitation, if not resentment.

*Operative Treatment*—The open method, with its assurance of immediate, accurate reposition of fragments and ultimate restitution of function, appeals strongly to most surgeons who are in the habit of associating ideal restoration with the best possible functional results.

Despite the analytical investigation of fracture treatment, as recorded

in the tremendous volume of literature which has accumulated in the past decade, it is still a fact that choice of method conforms to no fixed law

While conservatism, as taught by those who are its masters, meets present day requirements in a vast majority of cases, operative treatment is *imperative* in an ever varying minority. Collateral conditions, personal preference and experience will ever be responsible for the wide discrepancies in individual practice of extremists, as illustrated by Bardenheuer on the one hand, and Lane on the other. In the final analysis, true conservatism finds expression in the nearest approach to ideal end results, and this consideration must, in the long run, determine action.

It is fundamental that repeated efforts at bloodless reduction, under the most favorable conditions, must be made before conservatism is abandoned. Good alignment and minimum displacement meet ordinary requirements. Over-riding of fragments, spiral displacements, and interferences will certainly prove a serious obstacle to permanent reduction and a menace to future efficiency.

The propriety of operative treatment of fractures was suggested by E. S. Cooper,<sup>11</sup> of San Francisco, in 1861, when he anticipated Sir Joseph Lister and successfully opened the knee-joint and wired a fracture of the patella, relying upon alcohol as a wound dressing. He, also, removed a floating cartilage from the knee-joint in 1859. Cooper, however, was regarded as a dreamer, and his work remained in obscurity until Lister,<sup>110</sup> in 1871, announced that, with immunity from infection then attainable, the knee-joint could be opened in the presence of patellar fractures with almost absolute safety.

It is interesting to note that, prior to this date, 1870, Lister successfully treated an old fracture of the ulna and dislocation of head of radius. Through his teaching, the open treatment of patellar fractures came to be regarded as an accredited procedure. It seems strange that, with the precedent thereby established, the open treatment of recent fractures of long bones did not at once attract serious attention. Resort to this method was had sporadically until early in the last decade of the last century, when it became more general.

About twenty years ago W. Arbuthnot Lane became an earnest advocate of the operative treatment of fractures, and by him the method became popularized. His use of metal fixation material has been followed by a large number of surgeons throughout the world, until the Lane plate has become a household word in most hospitals. Gradually, however, it has been discovered that the use of foreign material in large volume, as advocated by Lane and his followers, is not without

serious disadvantages, and it is to be regarded as fundamental that the smallest possible amount of such material gives greatest assurance of ultimate success. It is proven beyond doubt that the presence of metal plates and screws exerts a deterrent effect upon bone repair. The following case admirably illustrates this point.

So recently as June 3, 1915, a patient presented himself at my office, with the following history. A healthy man, age thirty-five years, six months previously had sustained a fracture below the middle of the tibia and fibula. Ten days later, the fragments being irreducible, a competent surgeon operated and fixed the fragments with a Lane plate nearly four inches long, which required four screws. The wound healed promptly and the patient, after remaining in the hospital for two months, was discharged with an apparently perfect result. Union, however, was not solid. Gradually there developed an antero-posterior angulation, with manifest pseudarthrosis. I at once referred the patient back to his surgeon with the suggestion that he remove the plate, correct the deformity, and await results. It seems probable that further operative interference will be necessary, before good union is secured.\*

Before this Association, in 1897, Joseph Ransohoff<sup>12</sup> presented a paper upon the operative treatment of recent fractures, and reported seven successful cases. He stated his opinion, as follows:

"Except in the simplest variety of fractures, we share with our predecessors the anxieties that attend incomplete reduction, deformity, shortening, and loss of function." He expressed implicit faith in the legitimacy of the open method, but cautioned against indiscriminate resort to it.

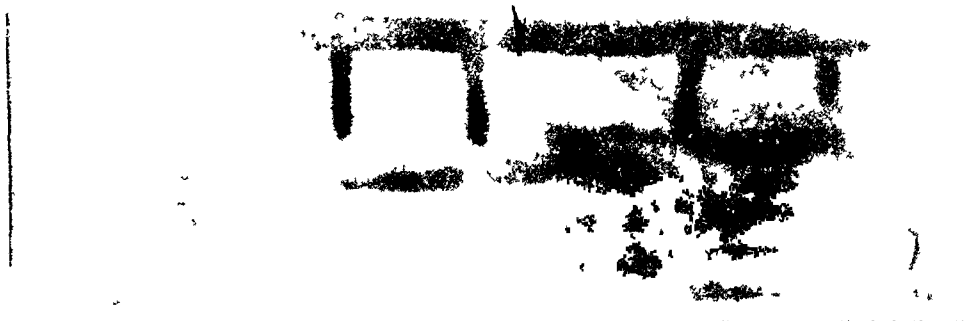
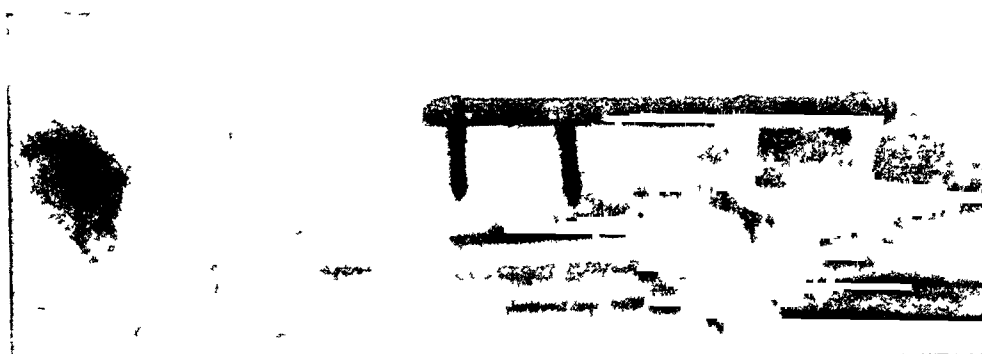
Campiche,<sup>13</sup> of San Francisco, maintains that "open operations on recent closed fractures, as they are done to-day—wholesale and indiscriminately—are unnecessary in most cases," and adds, "that conservatism will succeed in 90 per cent of cases."

Of 2100 fractures of all types, treated at Roosevelt Hospital, in two years, Darrach<sup>14</sup> found that 104, or 5 per cent, required open operation. His operative results in recent fractures were ideal in 71 per cent, fair in 21 per cent, bad in 8 per cent. His results in old fractures were good or ideal in 30 per cent, fair in 47 per cent, bad in 23 per cent.

In 21 of 56 recent cases, he employed no fixation appliances, depending solely upon readjustment and interlocking. In 17 cases,

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\* August 1, 1915, union still manifest





he used simply catgut suture Foreign material was used in but 18 cases For the maintenance of alignment, he relies wholly upon external splints

F J Cotton <sup>15</sup> believes that a *large percentage* of fractures cannot be reduced and held in place without operation He expresses the further opinion that one-half of the fractures of the femur and one-fourth of those of the humerus will be subjected to operation in the near future

Surgeons, generally, are not in accord with the opinion of Robert Jones, who opposes operative interference in fractures of both bones of the forearm at or near the middle

When it is considered that the muscular thrust upon the four fragments involved in this fracture forms a serious obstacle to permanent reduction, the propriety of operation requires little to be said in justification

W I Terry, of San Francisco, in a personal communication, states that his operative results in fractures, generally, are superior to his non-operative, both as to time loss and restoration of function He operates under the stipulation that fixation material may be removed after union is secured He also states that, in compound fractures, direct fixation lessens the period of disability

In an exhaustive article upon "Fracture of the Capitellum," J H Jopson <sup>16</sup> reports 1 case which yielded a good result by open operation He refers to 9 cases studied by Carlton P Flint, 6 of which were subjected to operation Two of the 6 were compound and required partial resection In 3 cases, the fragment was removed, end result not given The sixth case was treated (by Stimson) by suturing the fragment in place with good result

Reviewing a large number of cases treated conservatively, he finds that the end results were uniformly unsatisfactory

Royal Whitman <sup>17</sup> reports 5 cases of fracture of the neck of the femur treated by the operative method without mechanical fixation He operates by the anterior route, freshens the ends of fragments, and places the patient in a plaster spica with abduction His results were excellent in each case

Sherman and Tait, <sup>18</sup> of San Francisco, approve of the open method by the transarticular route in certain joint fractures Their position finds ample support in the fact that the open method for fractures of the patella is highly accredited

Stillman, of San Francisco, in a personal communication, accords to the foregoing for shoulder, elbow, and ankle fractures



Through the kindness of Dr Emmet Rixford, of San Francisco, I have, recently, seen a case in which there was a transverse fracture at the neck of the radius. The upper end of the shaft was displaced forward. The head of the radius was turned out of the orbicular ligament, at right angles to its normal position, the articular surface pointing outward.

A few days later, Dr Rixford opened the elbow by a lateral incision over the capitellum and head of radius. The head of the radius was turned into place under the orbicular ligament, thereby securing accurate reposition without bone suture. There was perfect wound healing.

Five weeks later, the contour of the elbow was normal, and there was promise of resumption of normal function in the joint.

Dr Rixford makes a valuable comment regarding joint fractures, which fully explains certain features connected with these injuries.

He says, in a personal communication: "In joint fractures, if only epiphyseal bone is involved, there is little resultant callus. This is illustrated in fractures of short bones. If diaphyseal bone is involved, a greater amount of callus is produced, and becomes a menace to joint function and may result in ankylosis."

J Hogarth Pringle,<sup>19</sup> in a most interesting review of 230 cases of open fractures of long bones, at the Glasgow Royal Infirmary, makes the following observation: All of the 230 cases were treated by the open method. There were 207 males and 23 females. The age distribution was as follows: First decade 11, second 38, third 52, fourth 47, fifth 43, sixth 24, seventh 13, eighth and ninth 2.

Anatomical Classification		Immediate Amputation
Upper arm	39	20 or 51.2 per cent
Forearm	31	9 or 29 per cent
Femur	21	4 or 19 per cent
Leg	139	33 or 23.7 per cent

He calls especial attention to the seriousness of upper arm lesions, 51 per cent of which required immediate amputation. There was an attempt to save the limb in 159 cases. Direct fixation was used in 112 cases, with 9 deaths from various causes, and 7 secondary amputations. The balance recovered with a useful limb.

The average hospital residence was 62 days, the longest period, 200 days.

He advises thorough primary cleansing of the wound and enlarging the skin wound, when necessary, and removing loose fragments.

E W H Groves,<sup>20</sup> writing upon the subject of compound and

comminuted fractures, quotes Lane and Lambotte as opposed to operative interference, emphasizes the dangers from infection, advises extreme gentleness and minimum of interference. In selected cases, he uses an apparatus similar to that of Lambotte which depends, for fixation, upon external bars.

J. B. Murphy has, many times, and in unmeasured terms, condemned meddlesome interference in open fractures, and there seems to be a general consensus of opinion, on the part of surgeons of large experience, to the end that it is better to await the permanent closure of the external wound before resorting to radical corrective measures.

Recalling the fact that open fractures, like all lacerated wounds, are *ab initio* the seat of infections, it is obviously hazardous to adopt any measure which will, almost inevitably, result in spreading infection.

With the free use of iodine, externally, and upon wound margins, we may reasonably hope that, in many cases, wound repair will progress rapidly, with the assurance of an early establishment of asepticity at the seat of fracture.

A signal advance in this field, during the past five years, is found in the use of the bone transplant, both in fresh and old fractures. After careful experimentation, the autogenous transplant has arrived at general acceptability, and it has been clearly demonstrated that the autogenous graft becomes a living entity in its new location. On the other hand, bone from a lower animal presents all of the objections urged against metal or other foreign bodies. Two methods of application have been advocated, first, the mortising of the transplant into the cortex of the bone, second, the placing of it within the medullary cavity.

Several instances of delayed union and of re-fracture, following the latter method, tend to discredit this procedure, on the ground that the medulla does not afford a proper habitat for the transplant, which, consequently, tends definitely to inhibit firm union.

According to Edouard Streissler,<sup>21</sup> Wilms recommended the use of bone grafts for recent fractures of the forearm, in 1909. Lexer, in 1908, suggested the use of the bone peg in the treatment of fractures of the femoral neck.

Regarding the importance of retained periosteum, in bone grafts, opinions vary greatly. C. A. McWilliams,<sup>22</sup> experimenting on dogs, insists that the periosteum should be retained, on the ground that it renders the transplant more permeable to blood-vessels, whereby its viability is assured. He thinks that Murphy overlooks the real value of this step. He reports 87 per cent of successes where the periosteum

was retained, and only 48 per cent of successes where the periosteum was removed

I have found that the periosteum of the graft may be preserved *in situ*, during operation, by wrapping the fragment closely with zero catgut. Before closing the wound, the strands of gut are divided and removed or cut short.

A P C Ashhurst<sup>23</sup> suggests that the periosteum is chiefly valuable in protecting the graft from ultimate absorption. In the treatment of fractures of the femoral neck, he employs anterior incision through the capsule, re-freshens the ends of fragments, and then drives a bone peg through the trochanter into the head of the bone. He reports one case with a fairly good result, but eight months later there was slight coxa vara, due to lack of precautions on the part of the patient.

J B Conant,<sup>24</sup> reviewing results attending fractures of the femoral neck, with reference to end results, concludes that they may be greatly improved by open operation and fixation of fragments with bone or nail.

E F Robinson<sup>25</sup> reports 5 cases of ununited fractures of the tibia treated by bone transplants, with uniform success. He states that there was union at the end of four, six, ten, eight, and seven weeks respectively.

F H Albee<sup>26</sup> calls attention to the manifest advantage of the inlay splint, as contrasted with the intramedullary graft. He states that the bone graft is a trustworthy surgical agent, and has employed it with uniform success in over 350 cases. He states that, even in the presence of a mild infection, the autogenous splint will survive. He contends that the bone graft should retain all its elements—periosteum, bone and marrow—and has wholly discarded the use of metal in any form. He employs this method in both recent and old cases.

G Freiherr von Saar,<sup>27</sup> in a paper upon the treatment of supra-condylar fractures of the humerus, says that, while many of these fractures, and especially those in young subjects, are amenable to conservative treatment, a considerable proportion in adults present insuperable difficulties and are best treated by the operative method. He proceeds by freely opening the joint and replacing the fragments. In those cases where the bone transplant is applicable, he does not hesitate to use it, and finds that, frequently, the detached portions of bone can be accurately replaced and the joint structure, thereby, made to resume normal conditions. He reports 6 complicated cases of this sort, occurring at the Innsbrucker Clinic, during the past two years, with excellent results.

## THE LITERATURE OF FRACTURES

In compound fractures, he advocates waiting until the external wound has healed before interference is undertaken. He refers to the work of Perthes who implanted, upon the lower end of the fragment, cartilage from the joint to secure later function. He insists upon long and patient orthopædic after-treatment in all his cases.

W. M. Brickner<sup>28</sup> is an ardent advocate of autoplasmic bone grafting in the presence of non-union. He reports two cases of non-union following the use of metal plates. Both were successfully treated by bone grafts. He relies upon external splinting for alignment, insisting that no plate or bone suture can be relied upon to perform this office.

His conclusions are: First, that metal plates often cause delayed or non-union, second, that the bone graft stimulates osteogenesis, third, there is gradually a fusion of the graft, but not complete absorption.

M. S. Henderson,<sup>29</sup> with a large experience, coincides with the views of McWilliams and retains normal periosteum. He reports 9 cases of fracture treated by autogenous transplant, 3 of which were originally compound fractures. In preparation of his graft, he uses a circular saw, and by preference uses the sliding method, thereby he takes the transplant from the fragments.

I wish to report 2 cases of old fracture of the femur of long standing non-union. The first was previously plated twice, and the second once. In the first case, a bone insert from the tibia succeeded perfectly. In the second case, I used an intramedullary splint, taking a segment of the entire fibula, without periosteum, for this purpose. In the presence of a slight infection, the transplant remained *in situ* until good union was established after a period of seventeen weeks. At that time, owing to a persistent sinus, I removed the transplant and the case was permanently cured. The resultant function in neither was ideal, but the best that could be secured under the circumstances.

A third case was that of an old ununited fracture of the humerus, treated by intramedullary transplant. This was an utter failure, though ultimate union, with good function, was secured by wiring.

These cases well illustrate the value of the implant as opposed to the intramedullary splint.

C. F. Walters<sup>30</sup> comments upon the use of the intramedullary bone peg as against the usual metal plate. He reports 4 cases with varying results and concludes that this method, in its present form, is unsatisfactory and inferior to bone transplant.

A comprehensive survey of the literature of fractures, covering the past ten years, has led me to the following conclusions:

*First*, the public demands, and is entitled to, better results from fracture treatment than have, hitherto, been obtained

*Second*, that from 80 to 90 per cent of long-bone fractures can be successfully treated by the closed method

*Third*, that conservative treatment exacts a high degree of skill and close attention to details

*Fourth*, that resort to the open method is of too frequent occurrence

*Fifth*, that the least possible amount of foreign fixation material should be the rule

*Sixth*, that steel plates, in the treatment of fractures, are a menace from the stand-point of permanency

*Seventh*, that the bone implant is the fixation material of choice

*Eighth*, that intramedullary splints are inferior to the autogenous bone implant

*Ninth*, that fixation material of whatever type is not to be relied upon for maintenance of alignment

*Tenth*, that cases of non-union and faulty union which come to secondary operation indicate indifferent methods of primary treatment

*Eleventh*, operative treatment of compound fractures should be withheld until the external wound healing is perfected

*Twelfth*, many joint fractures can only be treated successfully by the open method

*Thirteenth*, that normal contour and good function are closely related in end results of all fractures

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# END RESULTS OF BONE FRACTURES\*

REPORT OF THE COMMITTEE OF THE AMERICAN SURGICAL ASSOCIATION

BY W L ESTES, M D (*Chairman*)

THE committee has confined its investigation to fractures of long bones. The regions for study were established as follows

1 Upper Extremity

- (a) Humerus—(1) neck, (2) shaft, (3) condyle
- (b) Radius—(1) extremities, (2) shaft
- (c) Ulna—(1) extremities, (2) shaft
- (d) Both bones of forearm—(1) shaft, (2) Colles

2 Lower Extremity

- (a) Femur—(1) neck, (2) shaft—(a) upper third, (b) middle third, (c) lower third
- (b) Tibia—(1) extremities, (2) shaft
- (c) Fibula—(1) extremities, (2) shaft
- (d) Both bones of the leg—(1) shaft, (2) Pott's

Compound fractures are studied under the same divisions and classification as the simple ones are

The Committee sets itself the task of trying to determine especially three points

1 To find out the average present day results in both simple and compound fractures as regards anatomical and functional results in the several age groups, and the average time of disability. This latter period is determined to mean the average time the patient lost from work or his ordinary duties

2 The comparative value of (a) the conservative or closed methods, (b) the operative or open methods

3 The comparative value of immediate or delayed treatment in each group of cases

In order to accomplish the collection and examination of cases, a number of Fellows, surgeons in the various cities of the United States and Canada, were asked to serve as associate members of the committee. The following Fellows undertook the task of collecting and examining or having examined the end results of fractures in the hospitals of their respective cities: Dr M L Harris, Chicago, Ill., Dr J F Buchanan, Pittsburgh, Pa., Dr R Matas, New Orleans, La., Dr C L Scudder, Boston, Mass., Dr A F Jonas, Omaha, Neb., Dr A Primrose, Toronto, Canada, Dr A MacLaren, St Paul, Minn. We wish gratefully to acknowledge their very great help in this work

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\* Read before the American Surgical Association, June 9, 1915

## END RESULTS OF BONE FRACTURES

Also the Committee is indebted to Dr W E Lee, Dr Sergeant Martin, Dr C R Steinke and Dr R L John, all of Philadelphia, for their efforts in collecting and examining cases, and the free offering to the committee of the labor they had expended in personally examining and formulating the record of a large number of cases. The Committee wishes to give credit to these gentlemen and to offer them sincere thanks for their assistance.

The set of questions indicated by the accompanying blank form was used in collecting the data.

### AMERICAN SURGICAL ASSOCIATION COMMITTEE ON FRACTURES

1	Patient's Initials	Age	Occupation
2	Cause of Fracture	<div style="display: flex; align-items: center;"> <span style="font-size: 2em; margin-right: 5px;">{</span> <div style="margin-left: 5px;">           Direct Violence            Indirect Violence         </div> </div>	
3	Bone Affected	<div style="display: flex; align-items: center;"> <span style="font-size: 2em; margin-right: 5px;">{</span> <div style="margin-left: 5px;">           Neck            Upper Third            Middle Third            Lower Third            Condyle         </div> </div>	
4	Kind of Fracture	<div style="display: flex; align-items: center;"> <span style="font-size: 2em; margin-right: 5px;">{</span> <div style="margin-left: 5px;">           Transverse            Oblique            Spiral            Comminuted            Simple            Compound         </div> </div>	
5	Method of Reduction and Treatment		
	<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;">           a Anæsthetic or not?            b Fixation           <div style="margin-left: 20px;">             Closed Method           </div> </div> <div style="width: 45%;">             Open Method           </div> </div>		
1	Splints	Kind	1
2	Plaster of Paris		2
3	Traction	<div style="display: flex; align-items: center;"> <span style="font-size: 2em; margin-right: 5px;">{</span> <div style="margin-left: 5px;">           Buck's            Bardenheuer            Steinmann            Jones         </div> </div>	3
			4
			5
1			1
2			2
3			3
4			4
5			5
6	Amount of Shortening		
1	First dressings		
2	When all apparatus was removed		
3	When discharged from the hospital		
4	At latest observation		
5	State how measurements were taken		
7	Was X-ray used? At what stage of treatment		
	What did it show the position of fragments to be		
8	Length of time in bed		
9	Length of time crutches, canes, or other aids to walking were used		
10	Length of time absent from work		
11	Is patient able to take his former job?		
12	Disability at last observation, estimated by		
	a Deformity		
	b Endurance		
	c Pain		
	d Swelling		
	e Interference with joint function		
13	Mortality		
	%		
	a Cause of death		
	b Location and kind of fracture		
	c Age of patient		



The Committee collected 1745 cases, non-operative 1358 and operative 387. There were of the simple fractures 258 cases operated and of the compound 129 cases. The results of these cases have been carefully investigated.

Unfortunately the records of many of these cases were so incomplete they could not be used in their entirety.

The cases have been tabulated under six principal heads, viz

1 To show the results in the following age periods, viz (a) under 15 years, (b) 15-45 years, (c) 45-60 years, (d) over 60 years

2 To show the effect of good anatomical restitution in shortening the period of disability and restoring full function

3 To show the comparative results in the treatment of simple fractures of the operative (open) method and the non-operative (closed) method in the several age groups

4 To show the result of the operative and non-operative methods in the treatment of compound fractures also considered as regards the several age groups

5 To show the results of treatment of the fractures of the several long bones in the various regions, in the several age groups in order to determine the average period of disability and to standardize the average recovery

6 To show the comparative results of immediate and delayed treatment of the closed and open methods of treatment in the several age groups

The operative cases are considered as (1) immediate and (2) delayed

It was determined to class all operations performed within ten days after the injury under immediate operation, those done after this period are classed as delayed operations

The results of cases of non-union and those following operations for deformities resulting from fractures are not included nor considered in the report at all

The Committee finds

First, the results are best in the age period under fifteen years. Conservative treatment is generally effectual during this period.

Second, good anatomical restitution of a fractured long bone always results in the best functional result and has the shortest period of disability.

Third, while few open operations are reported under the fifteen-year-age period it seems to make little difference in the result, except in senile cases, what the age period is when the operation is done.

## END RESULTS OF BONE FRACTURES

Fourth, the end results of non-operative and operative treatment of compound fracture show very little difference in the anatomical result, but the functional results are better after operative treatment, except in compound fracture of the shafts of both bones of the leg, here the reverse seems to be true

The age period except in senile cases has no marked effect on the result of the treatment

Fifth, the average period of disability (that is, the time lost from work) in simple fractures is as follows

For fracture of the shaft of the humerus	14 weeks
For fracture at head and neck of the humerus	11 5 weeks
For fracture at condyle of the humerus	9 0 weeks
For fracture of the shaft of both bones of the forearm	10 8 weeks
For fracture of the femur, all sites	7 37 months
For fracture of the leg, all sites	4 75 months

NOTE—These averages must not be considered as absolutely conclusive, as so comparatively few records have the point accurately noted

Periods of disability were not recorded accurately nor generally in compound fractures. The reporter finds in his own cases (51 in number), the period of disability to be,

For fracture of the femur	13 months
For fractures of the leg	6 months
For fracture of the upper extremity	4 months

Sixth, the humerus should not show more than 1 cm shortening and no appreciable angulation. Musculospiral paralysis should not result

The forearm bones should show no appreciable shortening and pronation and supination should be unhindered. Function should always be good and no lasting pain result

Fracture of the shaft of the femur should not result in shortening greater than two centimetres, nor in a fixed position of angulation or rotation which will affect the joints and require new habits of balancing or tilting of the pelvis, joint function should be good. No permanent disability of the affected member should result

Fracture of the shaft of the bones of the leg should result in no appreciable shortening and no angulation. Joint function should be preserved

Seventh, there is no method or splint universally applicable, nor has any given splint or apparatus proved its superiority. All depends upon the discrimination of the surgeon and the manner in which the apparatus is applied and maintained

It is evident that traction methods are most frequently unskilfully employed. As a rule, too little weight is used. *The gauge of the proper weight required is that necessary to overcome the shortening.* This should be determined by careful daily measurement. Traction methods require, as a rule, countertraction.

Plaster casts and moulded splints are especially indicated and useful after a fracture has been satisfactorily reduced.

#### RECOMMENDATIONS

1 The committee recommends as a general principle that fractures be treated by a skilled surgeon.

2 X-ray should be employed by a competent radiographer, or a fluoroscope should be used for diagnostic purposes before the permanent dressing is applied. At least two skiagrams should be taken, and they should be taken from opposite perpendicular directions.

Skiagrams should also be taken after permanent dressings are applied to prove proper reduction, and at the end of the treatment to show the result of the union and for the purpose of a graphic record.

3 Fractures should be reduced immediately after the injury if possible to obtain and apply proper retaining apparatus or splints. The statistics show markedly better results when the treatment is begun at once. It is, however, not only useless but cruel to subject the patient to the pain of manipulation for reduction unless the surgeon has proper fixation apparatus at hand and the patient is where he may have a permanent dressing applied.

4 General anæsthesia should be employed as a rule to facilitate reduction and prevent pain, unless the condition of the patient contraindicates it.

5 Neither the non-operative nor the operative method is to be recommended exclusively. Each has its indication and should be employed when required. Generally speaking, the age period under fifteen years is the period in which non-operative methods are especially effectual. In the other age periods up to sixty years, operative methods may with confidence be employed when non-operative treatment has proved ineffectual in reducing, or controlling the fragments in proper position. The operation should not be delayed longer than one week after the injury.

6 The open method when adopted should be employed early. It may be used at any age period, except in senile cases, whenever a skiagram shows a deformity or a position of the fragments which

## END RESULTS OF BONE FRACTURES

obviously cannot be reduced or when proper efforts at reduction and retention have proved unavailing

7 Some form of rigid plate applied directly to the bone or an Albee "inlay" seems to be the best fixation method in operative cases

8 Open operations for simple fractures should be undertaken only by experienced surgeons who are thoroughly equipped by training and who have proper instruments and apparatus to meet all the possible indications of the operation

9 The work of this committee has been greatly hampered by the inadequacy of the records submitted for its consideration. A large proportion of the cases had to be rejected entirely and most of them were so incomplete as to make deductions based upon them possibly misleading

The first step in the betterment of practice is the study of results achieved by present day methods. An adequate study is impossible without adequate records

The committee strongly urges the American Surgical Association to set its seal of approval upon the standard form of record submitted by the committee, and to further petition the American Medical Association to do the same. The committee also urges each member of this Association faithfully to keep these records in his practice and to see that they are kept in the hospitals to which he is attached

The committee further recommends that a copy of the approved form be sent to all corporations within the United States of sufficient importance to have their own relief organizations or medical service or both, to all accident insurance companies to be embodied and incorporated in the papers given to the insured, with the requirement that they be filled at the time of an accident involving fracture, to all hospital boards with the request that these records be made a part of the routine records of fracture patients, pointing out that thus not only are the hospital and its surgeons protected in case of litigation, but that most valuable material is being collected to serve for attaining better results in the treatment of fractures

# AUTOPLASTIC REPAIR OF FRACTURES OF NECK OF THE FEMUR

BY CHARLES DAVISON, M D

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DURING the past year reports have been published by Albee,<sup>1</sup> Henderson,<sup>2</sup> Ashhurst,<sup>3</sup> and others on the autoplasic repair of ununited fractures of the neck of the femur and by the writer <sup>4</sup> on the autoplasic repair of recent fractures at the same location

Failures and unsatisfactory results have been reported on several occasions, but an analysis of the reports in the unfavorable cases seems to indicate that these results were due to the errors in technic in the operation or after-treatment, necessarily accompanying any new surgical procedure, which should rapidly be eliminated by additional experience

Improvements in technic apparently can be made along the following lines

I *The Selection of the Transplant*—The experience of the writer indicates that a section of fibula makes the most satisfactory transplant for either recent or ununited fracture of the neck of the femur, because

- 1 It is the size of bone adapted to the purpose
- 2 The requisite length is easily obtainable
- 3 It is irregularly round and will not rotate like a dowelled peg
- 4 It is a tube of compact bone which is mechanically stronger than the same amount of compact bone in a solid piece
- 5 It is lighter than a solid sawed peg
- 6 Its elasticity is greater than a solid transplant, more closely conforming to the elastic character of a normal neck of the femur
- 7 It is filled with undisturbed marrow which aids in the viability of the transplant
- 8 It presents a continuous circular surface of the cambium layer to the host bone for grafting and to stimulate osteogenesis in and around the defect

The transplant should be obtained from the fibula of the same extremity, limiting the operation to one extremity

The periosteum should be stripped from the transplant as it is removed, because the periosteum is a limiting membrane of fibrous tissue and when buried in bone its presence prevents bone to bone apposi-

tion and the grafting process which is essential to the repair of the fracture

After the periosteum has been removed the surface of the fibular peg should not be further disturbed in order to preserve the cambium layer, rich in osteogenic cells lying upon the surface of the compact bone beneath the periosteum and especially active in the grafting process

The canal in the femur should be fitted to the fibular peg, not the peg to the canal, as trimming the peg would thin the tube of bone and lessen its strength

II *The Application of the Transplant to the Fracture*—The published Rontgenograms of the cases which resulted unsatisfactorily show that the transplants were placed in the soft cancellous bone at nearly a right angle to the shaft of the femur, a poor bone support for the transplant against intermittent muscular spasm and a bad angle of leverage for the transplant in weight bearing

A better application of the transplant to this fracture is illustrated by a longitudinal section of a prepared fresh specimen, showing a fibular peg across the line of fracture impinging upon the bony points of leverage which support the head and neck of the bone in their normal anatomical alignment (Fig 1)

The bone peg rests at *A* on a strong mass of compact bone, reinforced by the base of the lesser trochanter. The lower end of the peg is held securely in the opening made for it in the compact bone of the shaft at *B*, and the upper end is firmly imbedded in the transitional bone against the cartilage at *C*. The peg is placed so that it acts as a powerful lever, with *A* as the fulcrum, *AB* acting as the long arm and *AC* as the short arm of the lever supporting the upper fragment

The wide angle *C A D*, about 135 degrees, between the peg and the axis of the shaft of the femur, materially increases the mechanical strength of the autoplasmic repair at the line of fracture and substantially increases the resistance of the peg to cross-breaking strain at the line of fracture when the weight of the body is sustained in walking

The upper end of the peg impinges against the cartilage of the head of the bone above the depression for the attachment of the ligamentum teres, otherwise the nutrient artery of the head of the bone which enters through that ligamentum might be destroyed and necrosis of the upper fragment occur. The firm bone at the point of the depression to receive the ligament is correspondingly thinner and would give less support for the peg

III *The Immobilization of the Fracture and Transplant*—It is

essential to the grafting process that the autoplasmic peg remains in stable contact with the recipient bone, without any motion whatever between them, to accomplish which, all muscular spasm and all leverage movement on the transplant at the line of fracture must be prevented

The muscular spasm can be prevented by relaxing the muscles concerned by the position of immobilization of the extremity. Abduction and external rotation of the thigh relax the muscles attached to the greater trochanter, flexion and outward rotation of the thigh relax the iliopsoas muscle, abduction of the thigh causes the iliopsoas to pull the fragments directly together after reduction in fracture of the neck of the femur, flexion of the leg on the thigh relaxes the hamstring muscles, consequently, to prevent muscular spasm and intermittent movement between the graft and recipient fragments, the thigh is strongly *abducted* and strongly *rotated outward*, slightly flexed on the trunk and the leg slightly flexed on the thigh

The hip-joint should be immobilized in this position by a strong body plaster-of-Paris cast. If a short spica is used the patient will be able to tilt the pelvis and change the position of the hip-joint on the injured side by bending the spinal column, consequently, the spinal column should be immobilized by a wide body part of the cast fixed against the thorax. If the opposite hip-joint is allowed to remain free, the patient will be able to tilt the pelvis and shift the position of the fractured hip, consequently, the opposite hip-joint should be immobilized by including the uninjured thigh in abduction in the body cast (Fig. 2)

This immobilization should be retained during convalescence, until the fibular transplant has grafted to the surrounding bone and union has occurred between the fragments

The immobilization should be retained without change for eight to ten weeks, and weight bearing should be prohibited for some time longer in recent fractures of the neck of the femur. A very much longer time is required for repair and regeneration of bone in ununited fractures of the neck of the femur, depending in the individual case upon the length of time after the original fracture, the condition of the small fragment, as to its viability and amount of absorption and the general condition of the patient. Rontgenographic examination will demonstrate the condition of the repair and should determine the length of time of immobilization. Body weight bearing should not be allowed until the Rontgenogram shows repair of the pseudarthrosis and not until functional movements of the hip-joint have been restored

Autoplasmic repair of the neck of the femur for either recent or ununited fracture is contra-indicated in the aged, where the shock of

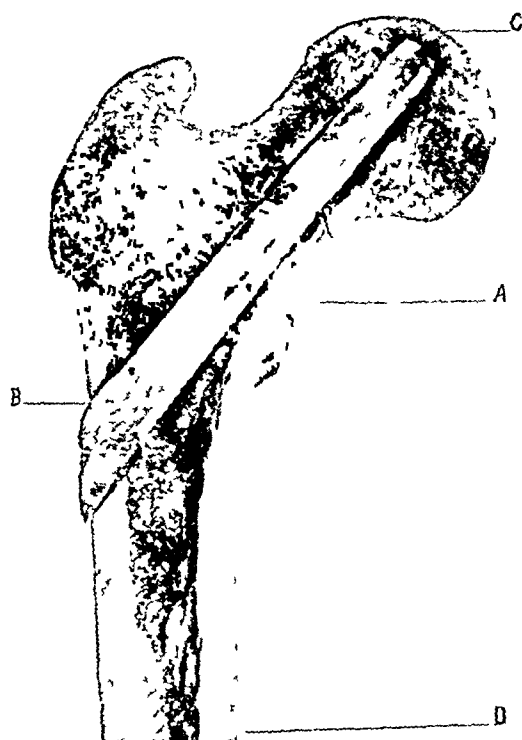


FIG 1 —Longitudinal section of a prepared specimen illustrating repair of fracture of the neck of the femur by a fibular peg



FIG 2 —Position of immobilization in autoplasmic repair of fracture of the neck of the femur



FIG 3 —Case I Photograph of post-mortem specimen of united fracture of the neck of the femur





FIG 4—Case I Photograph of a longitudinal section of Fig 3 showing union between the fragments and grafting of the transplant to its host



FIG 5—Case II Photograph of post-mortem specimen of ununited fracture of the neck of the femur



FIG 6—Case II Röntgenogram of Fig 5

## FRACTURES OF NECK OF THE FEMUR

operation, the effects of anæsthesia or the prolonged immobilization might seriously endanger life

The results of a personal operation for autoplasmic bone repair for recent fracture of the neck of the femur are extremely illuminating as showing the course of early bone production around the transplant in the cancellous bone of the neck of the femur and the rapid union of the line of the fracture

CASE I—A fracture of the neck of the right femur, in a patient fifty-six years of age, was repaired twelve days after the injury by the insertion of a fibular transplant. The wounds healed by primary union. The patient died twenty-three days after operation.

The pathological specimen showed good union at the line of fracture (Fig 3). A longitudinal section through the head and neck of the femur and the fibular transplant showed the following conditions (Fig 4).

The transplant was solidly embedded in the surrounding bone, being substantially attached both to the cortical bone to which it was contacted and to adjacent cancellous bone of the neck. Radiating from the graft in every direction was a mass of hard bone, infiltrating the cancellous bone and grafting the transplant firmly to its host. The medullary canal of the fibular transplant was sealed at each end by a plug of hard bone and the remainder of the canal was filled with marrow.

The line of fracture was not discernible on the cut surface of the section of the specimen.

CASE II—A fracture of the neck of the right femur, in a patient fifty-four years of age, was treated by open operation and internal fixation with a large metal screw, seventeen days after the injury. The wound healed by primary union. The patient died twenty-five days after operation.<sup>5</sup>

The pathological specimen (Fig 5) showed only fibrous union between the fragments. The screw was loose and movable in the trochanter, which with the fibrous union allowed considerable movement between the fragments. A Rontgenogram of the specimen showed the direction and position of the loose screw (Fig 6).

### CONCLUSIONS

1 Autoplasmic transplantation of bone is the best treatment for both recent and ununited fractures of the neck of the femur, unless contra-indicated by age or condition.

2 The fibula furnishes the transplant of choice.

3 *The transplant impinging on the points of compact bone as described will graft to these points of leverage and give strong support to the line of fracture*

4 The transplant imbedded in cancellous bone will stimulate the production of osteoblasts and the growth of new semicompact bone in the cancellous area around the transplant, grafting them together by bony union

5 *The transplant must be completely immobilized until it has grafted to the recipient bone*

6 *The position of immobilization must be extreme abduction and external rotation of the thigh*

7 The plaster case to be effective must extend from the axilla to the toes on the injured side and also include the opposite thigh in abduction

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- <sup>5</sup> Reported by permission from the records of a colleague

# EXTENSION AND REDUCTION OF TRANSVERSE OR SERRATED FRACTURES OF THE FEMUR ✓

BY HERBERT GIFFORD, M D ,  
OF SYRACUSE, N Y

A METHOD which the author has found extremely advantageous in reduction and immobilization of those fractures of the lower portion of the femur whose fracture planes are either transverse enough or jagged enough to catch and hold each other once they are well reduced, may be described under the three heads of material, technic, and mechanics, as follows

(I) *Material*—1 Table, substantially built One may be improvised with legs of 2 x 4 of convenient height, well braced, top of two pieces of 1 or 2 x 6, laid with a longitudinal space of two or three inches between them The table is firmly anchored to the floor, and to one end of it an ordinary hospital back-rest may be attached, though the latter is not strictly necessary

2 Swath, preferably of outing flannel, from five to ten inches wide, and from five to ten yards long

3 Metal strap (Norway iron is good stuff), from one to three-sixteenths inches thick, and from half to one and a fourth inches wide, long enough to outline the well-padded foot and leg from the lower calf behind, beneath the sole, and up to the upper third of the leg in front (See Fig 1, B) This prevents the ankle bending

4 Wooden splint (constructed as in Fig 1, A, and applied as in Fig 3), reaching from the toes to the loin as the knee is fully flexed.

5 Block and tackle, capable of sustaining traction of at least five hundred pounds

6 Loop of rope, long enough to reach from the sole above the flexed knee

7 Cotton, sheet-wadding, plaster-of-Paris bandages, anæsthetics, etc

(II) *Technic*—1 Bandage the metal form to the well-padded foot and leg, at the same time catching the rope loop beneath the sole and at the sides of the leg

2 Secure patient to the table by passing swath across the anterior superior spines, beneath table, up through one side of perineum, etc This both holds the pelvis firmly to table, proximal fragment with it, and in passing over the perineum engages the neck of the femur, guarding it against a possible dislocation under strong traction

3 Administer anæsthetic briefly, but to sufficient degree of relaxation

4 Flex knee fully, a pad of sheet wadding being placed between calf and thigh, adjust the tackle, and the bridge shown in Fig 2, "A"

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\* Read before the Syracuse Academy of Medicine, April 6, 1915

5 While an assistant makes traction, the tibia engaging the overhanging condyles, the surgeon steadies the leg and foot as in Fig 2, gently jockeying the leg and with it the distal fragment through the rigid lateral ligaments of the knee, to assist the ends in clearing, and the distal fragment to mount into its place upon the proximal, when the ends should be gently but firmly ground together (A fluoroscope is valuable though not indispensable)

6 When the measurements are well adjusted, as shown by the measurements or the fluoroscope as traction is relaxed, they are guarded against redispacement while the metal strip is removed, the wooden splint and plaster applied as shown in Fig 3, binding foot, leg, thigh, and pelvis together in one solid mass, though no dangerous nor uncomfortable pressure is necessary When the dressing has hardened the patient is carefully returned to bed, pillows supporting the limb from falling sidewise

In my experience, while each case must be judged alone, twenty days are usually sufficient in simple cases to warrant removal of the plaster dressing, and beginning the gradual straightening of the knee

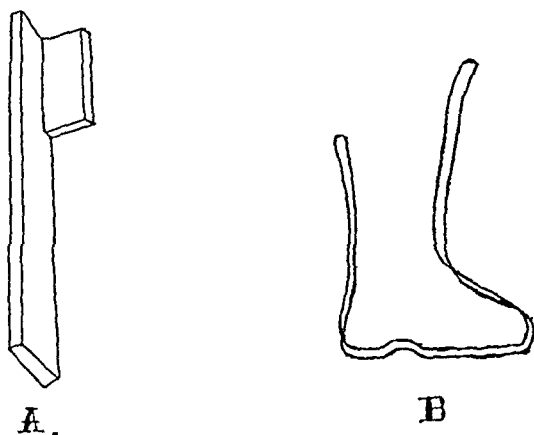


FIG 1 —A, wooden splint (for material see p 289) B, iron strap foot and leg piece (for material see p 289)

After removal of the plaster dressing, the patient is permitted to roll about in bed for a week or ten days, the injured member supported by padded splints bandaged on About the second month crutches may be adopted, and weight bearing resumed as it may be done with entire comfort—a matter quite safely to be entrusted to the patient

In cases of compound infected fracture, windows may be left in the plaster for drainage and counter-drainage, openings for which should be made between the wound and the trunk so as to facilitate drainage by gravitation

(III) *Mechanics* —The appended table shows the distances between the points of attachment of the muscles affecting the relations of the

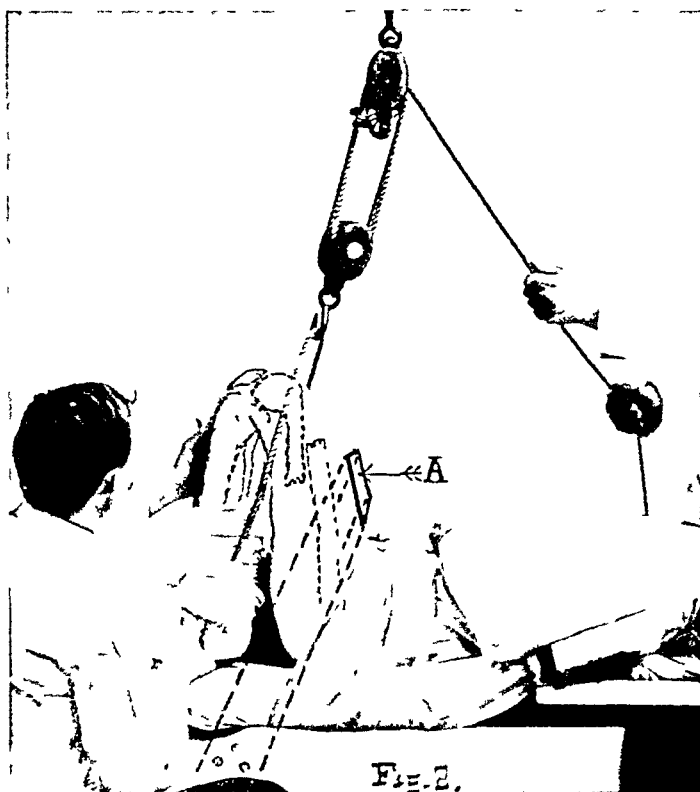


FIG 2 —Author s method of applying extension

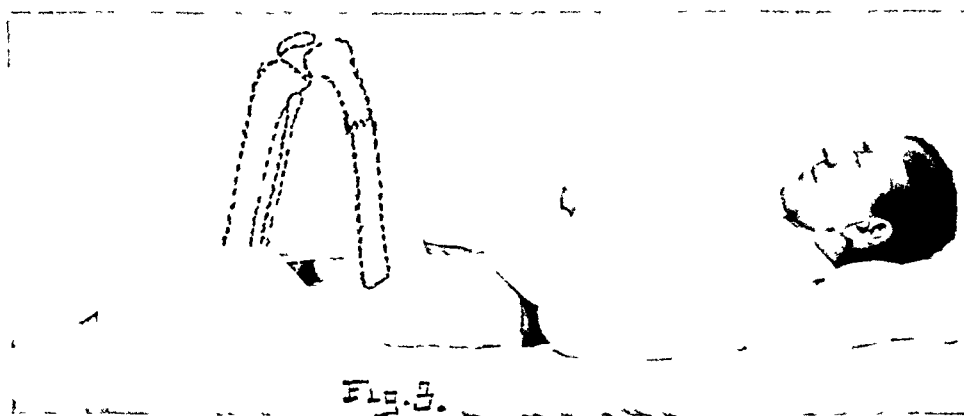


FIG 3 —Showing dressing applied after reduction of fragments



FIG 4 —Transverse fracture of femur before reduction (4½ inches overriding)



FIG 5 —Fracture reduced

# EXTENSION OF TRANSVERSE FRACTURES OF THE FEMUR

fragments of a broken femur, in those combinations of flexion and extension of hip and knee commonly used in such cases, viz double extension (hip 180°-knee 180°), the Hodgens position (hip 45°-knee 45°), the suspension used in children (hip 90°-knee 180°), and the 90°-30° combination of this paper

From the table it may be seen that in the 90°-30° combination of which advantage is taken in the method here under discussion, all the muscles involved are relaxed except three, viz, the gluteus maximus, the quadriceps extensor femoris, and the lower portion of the adductor magnus. The tightening of the gluteus maximus is wholly favorable, tending to hold the proximal fragment back, the slight tension of the quadriceps only enables it the better to serve as an anterior splint, preventing forward angulation and displacement at the site of fracture, the tension of the lower portion of the adductor magnus is increased, it is true, which would seem to be disadvantageous, but from the fact that the tendency to lateral displacement is only slight at most, the disadvantage cannot be great, and is easily counteracted by the intact leg bones serving as a splint to the broken femur, especially by virtue of the lateral rigidity of the knee-joint. On the other hand, the muscles which would seem to be most active in producing the classical displacement by which the proximal fragment is drawn forward and the distal fragment tilted backward and downward, viz, the thigh flexors, the upper adductors, the hamstrings, the gastrocnemius and popliteus, particularly the last two, are markedly relaxed.

	Hip 180° Knee 180°	Hip 45° Knee 45°	Hip 90° Knee 180°	Hip 90° Knee 30°
Psoas and iliacus	7	6½	5¾	5¾
Gluteus { Maximus	7	7½	7¾	7¾
{ Medius	5	5	5	5
{ Minimus	3	2¾	2½	2½
Pectineus	4½	4	3¾	3¾
Sartorius	19	18½	18	13½
Quadriceps extensor femoris	19½	19	17	20½
Gracilis	19	18½	18½	13½
Adductor { Magnus { Upper	5	4½	4	4
{ Middle	8½	8¼	8	8
{ Lower	13½	14½	16	16
{ Longus	7	6¾	6½	6½
{ Brevis	6	5½	5	5
Semitendinosus and semimembranosus	19	19½	22½	15
Biceps	17	18	20½	16
Gastrocnemius	18	17½	18	15
Popliteus	5	4¾	5	3

NOTE —Black type figures denote increase of distance and tension



Should the ends become unseated now and then, the situation is quickly betrayed by the marked disparity of height between the two knees, as shown by measurements from anterior superior spines to the patellar level, or radiographs, the anæsthesia is so brief, and the shock so negligible, that the reduction may be repeated as often as may be required

As shown by the illustrative radiographs (Figs 4 and 5), the method seems to work well enough to warrant its recommendation to the profession for trial in those cases to which, according to the opening paragraph, it applies

# NOTES ON FRACTURES\*

BY WILLIAM J RYAN, M.D.

OF PHILADELPHIA, PA

THE following report is based on the "follow-up" records of 121 fractures treated in the Surgical Dispensary of the St Agnes' Hospital, of Philadelphia, from February 1, 1914, to August 1, 1914, and in Dr Muller's Clinic in the Polyclinic Hospital during 1914

Seventy-four patients were traced, and, while we were disappointed in the limited scope of the investigation, certain details seem of interest

	Total cases	Traced
Nose	3	0
Inferior maxilla	4	1
Zygoma	1	0
Ribs	6	3
Clavicle	10	6
Acromial process	1	0
Humerus	18	13
Radius	31	23
Ulna	7	4
Radius and ulna	6	4
Metacarpal	10	7
Phalanges of finger	6	3
Tibia	7	4
Fibula	7	4
Metatarsal	4	2
Total	121	74

One fracture of the inferior maxilla was heard from This case had no disability or deformity but complained of occasional slight pain when exposed to cold

Of 3 fractures of the ribs traced, 1 had died of pneumonia, and 2 had had pleurisy They were all men over fifty The pneumonia case died out of town and we could get no definite information regarding his illness One of the cases of pleurisy was on the affected side Examination a year after the injury revealed no deformity along the line of the fractured ribs

Six cases of fractured clavicle heard from showed excellent functional results Two of them, of twenty and thirty years of age, showed considerable callus formation Fortunately, both were men

Thirteen fractures of the humerus were traced, 2 of the upper end, 2 of the shaft, and 9 of the lower end The first were both

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\* Read before the Philadelphia Academy of Surgery, April 5, 1915

impacted fractures of the surgical neck One man of forty-five, a bookbinder, is back at his regular employment The other, a man of seventy-four, has good firm union but has considerable pain on forced flexion and internal rotation Of the shaft fractures, 1, a four-year-old girl with a fracture below the insertion of the deltoid, has a perfect result, both anatomically and functionally A man who had an oblique fracture at the middle of the shaft with 1 inch shortening has some bowing backward of the humerus, but no shortening, and the functional result is excellent Nine fractures of the lower end were seen or heard from, 2 of the internal condyle, 5 of the external condyle, and 2 supracondylar All were in children and all were due to falls on the elbow which makes the greater frequency of the fractures of the external condyle rather extraordinary These were uncomplicated and all had good results One supracondylar fracture has limitation of extension, but flexion is as good as in the other arm This supracondylar fracture was accompanied by a fracture of both external and internal condyles, the line of fracture of both condyles converging as they extended downward There was extreme swelling and extensive bleb formation, which delayed active treatment of the fracture for four days

*Radius*—Of 31 fractures of the radius, 23 were traced These involved the upper end once, the shaft 4 times, and the lower end 18 times The fracture of the upper end was a chip off the flange-like head The case was a week old with a history of a fall on the hand which caused the elbow to bend, and the back of the forearm came in contact with the ground Jones's position gave an excellent result, there being no impairment of motion in the elbow, nor interference with pronation and supination

Four fractures of the shaft were traced, 3 being transverse cracks without displacement, and 1 oblique fracture about 4 inches from the lower end of the radius The obliquity was from behind downward and forward The functional result in this case was only fair, there being some interference with supination six months after the injury, due to failure of the patient to keep up his massage treatment He returned again for massage and now has almost complete power of supination

Eighteen of 23 fractures of the lower end were traced Sixteen were within  $1\frac{1}{2}$  inches of the lower end, and 2 were fractures of the anterior edge of the articulating surface Seven of the 23 fractures showed the classical silver fork deformity, the latter varying in degree All 7 were accompanied by a fracture of the styloid process of the ulna These were treated with anterior and posterior straight splints,



FIG 1 —Fracture of jaw of three months duration before treated Anatomical and functional results good Some pain in damp weather



FIG 2 —Fracture of middle of clavicle Three weeks old on admission

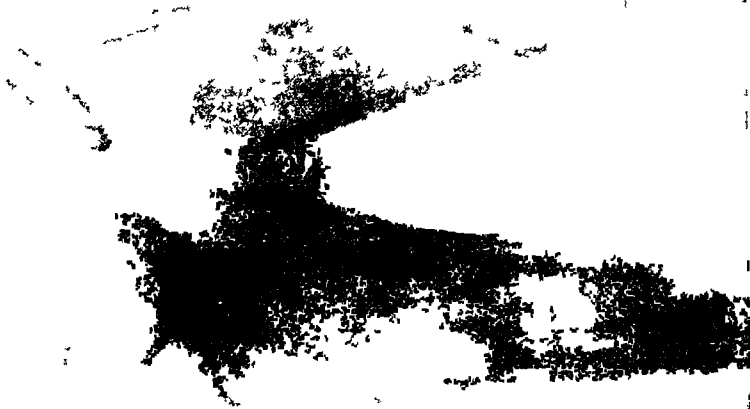


FIG 3—Male patient aged seventy-eight. Fracture of upper end of humerus and surgical neck, fracture of head including greater tuberosity. Result, good union, fair function, pain on extreme flexion and extension.

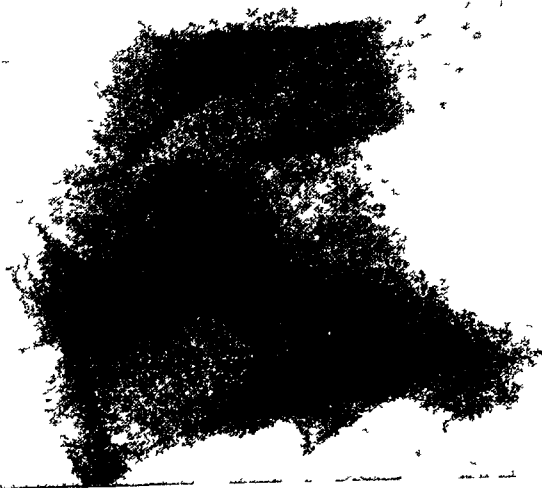


FIG 4—Fracture of upper end of shaft of humerus. Excellent result both anatomically and functionally.



FIG 5—Fracture of surgical neck of humerus. Excellent and functional results.



FIG 6 —Fracture of lower end of radius, comminuted fracture of styloid of ulna Anatomical result slight bulging in front of wrist, functional result good



FIG 7 —Impacted fracture of lower end of radius



FIG 8 —While playing fell from top step striking pavement with hand outstretched Examination disclosed backward bending of forearm about two inches above wrist. Anterior and posterior straight splints in position midway between pronation and supination. This plate taken after first attempt at reduction. This plate illustrates the case in which the upper fragments were split and in which the upper ends of lower fragments were caught in the split. See text page 295



FIG 9 —Greenstick fracture of both bones of the forearm. Result excellent



FIG 10 —Fracture of shaft of tibia treated by extension and plaster cast. Anatomical result slight prominence of lower end anteriorly, functional result excellent



FIG 11 —Fracture of both bones of the leg, considerable comminution. Functional result fair there being some stiffness of flexion



FIG 12 —Comminuted fracture of lower end of fibula



FIG 13 —Comminuted fracture of first and second metatarsals





the posterior being notched to keep from pressing on the prominent lower end of the ulna. All gave good functional results, but in all 7 there was a loss of the prominence of the lower end of the ulna. This alteration was not present in the following 9 cases, which were treated with a Bond splint. Seven were transverse fractures of the radius with little or no displacement, and 2 were epiphyseal separations. All have good functional and anatomical results.

I might remark here that 3 cases of this year's series with marked deformity and accompanied by fracture of the styloid of the ulna were treated with a Bond splint and, six weeks to two months after the injury, show no loss of prominence of the lower end of the ulna.

The two Barton's fractures were treated with anterior straight splint and have good functional results.

*Ulna*—Of the 7 fractures of the ulna, 4 were traced, 2 of the olecranon, 1 of the shaft at the junction of the lower and middle third, and 1 of the styloid. All were simple and showed good results.

*Radius and Ulna*—Four out of 6 were traced. Two were complete of both bones, with considerable displacement, 1 a girl eight years of age and 1 a woman of forty. One was greenstick of both bones, and 1 was a complete fracture of the radius with a greenstick of the ulna, the type reported by Dr Skillern before this Academy last year.

The fracture in the young girl was difficult of reduction because both lower fragments were split longitudinally about 1 inch, and the upper fragments wedged loosely in the split, the fracture occurring about 3 inches above the wrist. It was successfully reduced though and she has a good result both functionally and anatomically.

The result of the fracture in the woman is bad. She was struck on the back of the arm by a heavy poker, and on admission her forearm was sharply angulated at the junction of the lower and middle third. X-ray showed both lower fragments to be badly comminuted with encroachment by the radial fragments on the interosseous space. Plating was advised, but she refused, and we attempted to mould the fragments into position without much success. She has fairly good motion in her wrist but she can not completely close her fingers. Pronation and supination are also limited. There is slight bowing backward of both bones.

The greenstick fracture of both bones was simple and gave a good result. The case of Skillern's fracture has an excellent result. At the time of admission there was some backward angulation but we were able to reduce it without making the greenstick fracture of the ulna complete. All these cases were treated in full supination.

*Metacarpal*—Seven cases were heard from, 1 of the first, 4 of the second, and 2 of the fifth. All were accompanied by great swelling. The fracture of the first involved the head and extended into the joint. Dressing in full abduction and early massage gave a good result. The other 6 were simple without displacement and have excellent results.

Fractures of the phalanges were simple and uncomplicated and need only be mentioned.

*Tibia*—Four cases of fracture of the tibia were heard from. One of these cases was very interesting. The patient was a boy, ten years of age, who while running struck his leg against a sharp spike of an iron fence which had been bent outward towards the sidewalk. Close examination of the lacerated wound showed that a groove had been made in the antero-external surface of the tibia about  $\frac{1}{4}$  inch deep and about 1 inch long. There was no evidence of other fracture and a careful roentgenogram showed no fracture other than the groove. The other 3 cases were in children: 2 greenstick and 1 spiral fracture which was easily reduced. Plaster cast was used in these 3 and they have excellent results, all being able to run and play as before.

*Fibula*—Of 7 fractures of the fibula 4 were heard from. Three were Pott's fractures without involvement of the internal malleolus. Two were treated in the house in the usual manner and discharged in a week to return to the surgical dispensary. One was ten days old on admission and a plaster cast was applied in dispensary. The fourth case was at the junction of the upper and middle thirds and was caused by the kick of a horse. There was displacement backward of the lower fragment about  $\frac{1}{2}$  inch. After reduction a plaster cast was applied from the toes to the middle of the thigh. This man has now a hypertrophic arthritis of the knee of the injured leg, though X-ray at the time of injury showed nothing abnormal in the knee.

*Metatarsal*—Two fractures of the first metatarsal were heard from. Both were in the middle of the bone and were due to the fall of a heavy weight on the foot. One was accompanied by a fracture of the first and second proximal phalanges. It was greatly comminuted, the bone really being smashed, the other, by the first and second proximal and the third distal phalanx. In both there was entrance swelling and ecchymosis which required small incision. In first no displacement occurred. In the second there was angulation toward palmar surface. Both cases were treated with a moulded binder's board splint and a wide bandage over instep. (The functional result of the first is good, but the other case has to wear an arch support to relieve pain.)

# ON FRACTURES OF THE SESAMOID BONES OF THE THUMB\*

By PENN G SKILLERN, JR, M D

OF PHILADELPHIA

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THE following case represents the fourth example of fracture of a sesamoid bone of the thumb to be recorded in the literature

E B, male, white, aged twenty-six years, civil engineer, reported at the Surgical Out-patient Department of the University Hospital (Case record 61996) on March 2, 1915, with the history of having fallen three days previously in such manner that the left thumb was traumatized against the granite Belgian block pavement

This hand had never been injured previously Clinical examination revealed moderate swelling of the left thumb, ecchymosis along the thenar eminence, and "wincing" tenderness both at the head and at the base of the first metacarpal A clinical diagnosis was made of a "chipping" fracture of the metacarpal head Skiagram (Fig 1) revealed a fracture of the ulnar sesamoid bone opposite the head of the first metacarpal, the smaller fragment being separated distally, and there being a definite, dentate line of fracture There was also an oblique fracture at the base of the metacarpal, separating the ulnar corner and entering the carpo-metacarpal joint at its middle The thumb was immobilized in extension and slight abduction by a spica sodium silicate bandage

Re-examination after the reading of the skiagram brought out two additional facts In the first instance, the patient was loose-jointed, and could hyperextend both thumbs normally at the metacarpo-phalangeal joint In the second place, there was definite "wincing" tenderness, localized to the ulnar sesamoid bone After four weeks the immobilizing dressing was removed, and massage instituted

While the clinical diagnosis of "chipping" fracture of the metacarpal head was inaccurate, yet it was close enough to lead to the detection of the fracture of the sesamoid bone In order to parry the question of a congenitally bipartite sesamoid, a skiagram of the right thumb was taken (Fig 2), but no abnormality of the sesamoids was revealed This fact, together with the history of a fall upon the thumb, the clinical localization of "wincing" tenderness to the sesamoid, shown

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\* Read before the Philadelphia Academy of Surgery, April 5, 1915

involved by the skiagram, and the dentate line of the fragments in the skiagram contrasted with the smooth line of a bipartite sesamoid, points to a fracture

The other three cases were found only in the German literature

The first case was reported by Preiser, in 1907 (*Aerztl Sachverstaendigen-zeitung*, 1907, No 19, S 400) The patient was a woman, aged thirty years, who had fallen upon the right hand, fracturing both of the sesamoids of the thumb

The second case was observed by Morian, in 1905, but not reported until two years later, nor published until 1909 (*Deutsch Zeitschr f Chirurg*, 1909, H 102, S 394) The patient was a man, aged twenty-seven years, whose right thumb was caught between a closing door and the jamb Skiagram revealed a comminuted fracture of the ulnar sesamoid bone

The third case was presented by Maas, in 1912, in an inaugural dissertation entitled "Ueber Sesambein-Frakturen" (*Emil Ebering*, Berlin, 1912, 18pp), which reviews the subject and gives references to the literature, and which is the latest article that could be found at the time of preparation of this paper The patient was a man, aged fifty-three years, a wheelwright by trade, who was struck upon the left thumb by the end of an unfinished metal tire The skiagram Maas shows reveals a fracture very similar to that in my case, and involving the ulnar sesamoid bone In this case the tire was grasped between the thumb and the index finger, resting upon the ulnar sesamoid bone, which was thus directly exposed to trauma Skiagram of the right hand showed a normal state of the bones

As to the nature of the violence that produced the injury, whether direct or indirect, it is difficult to decide, for the mechanism of the fall was such that the one could operate as well as the other, and arguments could be brought forth in favor of either form The absence of comminution of the fragments, and their similarity in the skiagram to fractures produced experimentally by indirect violence, however, lead one to conclude that the latter variety of violence was effective The three previously reported cases, on the contrary, were due to *direct* violence But Morian criticises Preiser for rejecting indirect violence as the cause of the fracture in his patient, who, like mine, also fell upon her outstretched thumb

Experimentally, fractures have been produced by both forms of violence Preiser obtained results by direct violence, but could produce none by indirect violence Morian found it easy to procure fractures by direct force, and then made eight attempts to secure fracture by indirect force, in five of which he succeeded Of these five, in four both bones were broken (compare Preiser's case), while in the fifth the ulnar alone was involved In all, the line of fracture was transverse or oblique, and a small fragment was separated as often proximally as



FIG 1 —Fracture of ulnar sesamoid bone of thumb      Fracture of base of first metacarpal bone

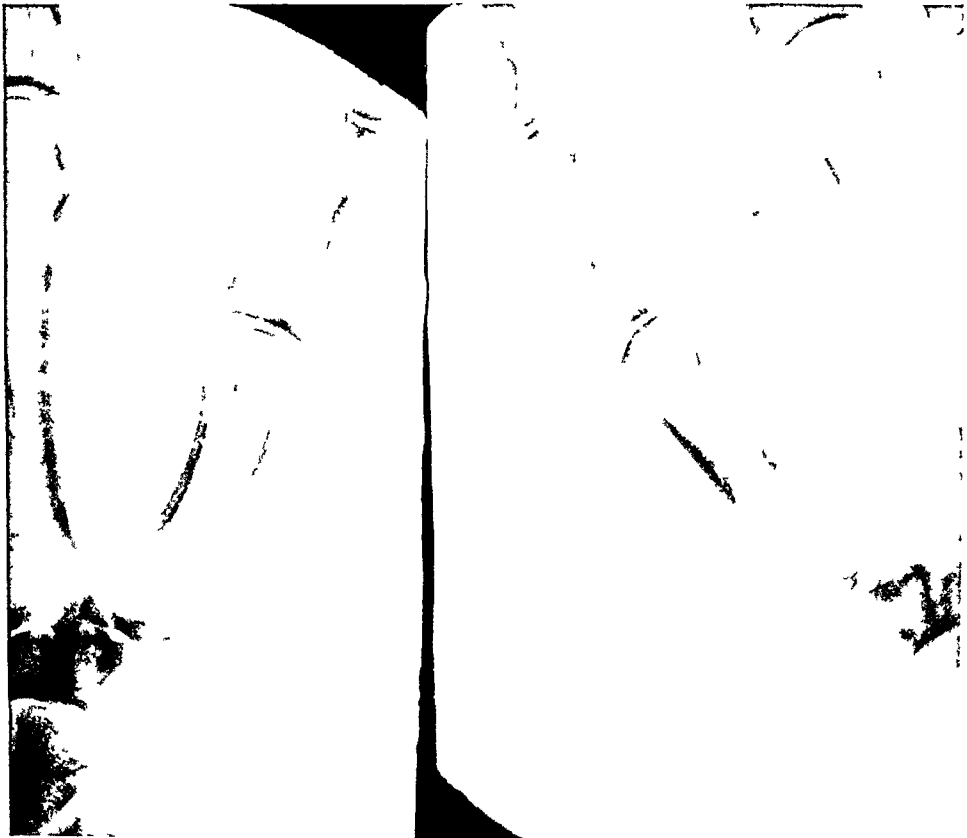


FIG 2 —Same as Fig 1      The normal right thumb is shown for comparison



## FRACTURES OF THUMB SESAMOIDS

distally with one exception, a radial sesamoid that was broken through the middle. Clinically, fractures by indirect violence, as obtains in fractures of the patella from a similar cause, are associated with more extensive laceration of the capsule of the joint.

In an attempt to clarify the subject I examined 22 thumbs in the Anatomical Laboratory, some of the results of which are shown in the cuts (Figs 3 to 9). The first sketch (Fig 3) shows the normal sesamoids *in situ*. The radial is typically larger and oval, and the ulnar smaller and round, and situated more distally. Both rest upon, or close to, the anterior border of the base of the proximal phalanx.

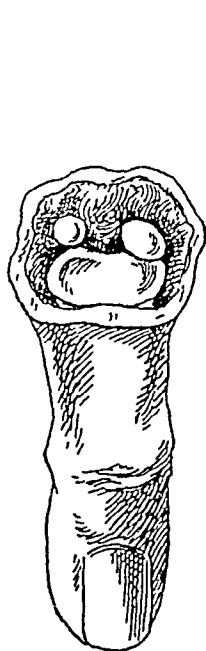


FIG 3 — Dissection showing normal sesamoids of thumb *in situ*. Radial is large and oval, ulnar is small and round.



FIG 4 — Dissection showing ligaments connected with sesamoids. One intersesamoid, two radial, three ulnar.

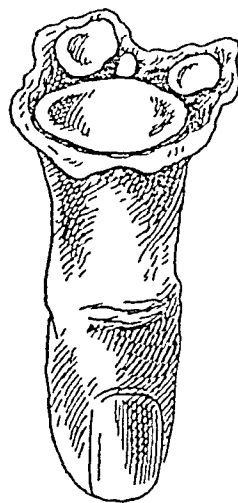


FIG 5 — Dissection showing bipartite radial sesamoid. Note smooth even edge.

Both are embedded in the capsule, receive insertions of muscles from the thenar eminence, and form a groove through which passes the long flexor tendon.

The second sketch (Fig 4) demonstrates what I have been unable to find any description of, namely, definite ligaments connected with the sesamoids, aside from that which binds the two bones together. In this specimen five definite capsular thickenings were found, of which two were associated with the radial, and three with the ulnar, sesamoid. These recall in miniature the picture of the patella with its quadriceps tendon and ligamentum patellæ, and the effect of sudden, forcible hyperextension upon the sesamoids seated upon the border of



the phalanx is fairly comparable with the patella resting upon the trochlea of the femur when subjected to similar strain. Instead of the ligament itself tearing it avulses a shell of bone, as in any other tear fracture.

The third sketch (Fig 5) shows a congenital division of the radial sesamoid. A similar condition of the same bone was also found by Preiser in his experimental investigations. Morian saw clinically a like state of the ulnar sesamoid in a patient whose daughter had a congenitally-cleft sesamoid of the great toe. But for the following points of differentiation, as emphasized by Stumme, one might be deceived by diagnosing fracture. In a congenitally-cleft sesamoid the components possess a smoothly-rounded and regular shape, while the fragments of

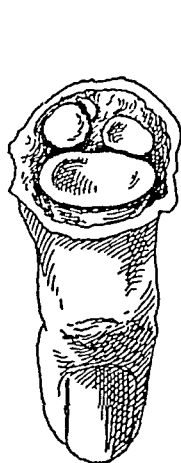


FIG 6 — Dissection showing tear-fracture of ulnar sesamoid experimentally produced

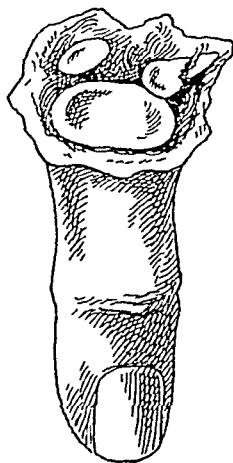


FIG 7 — Dissection showing tear-fracture of radial sesamoid experimentally produced

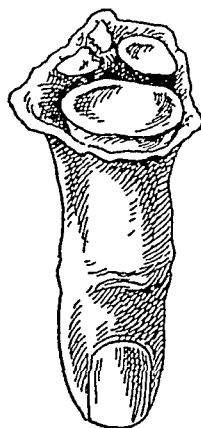


FIG 8 — Same as Fig 6

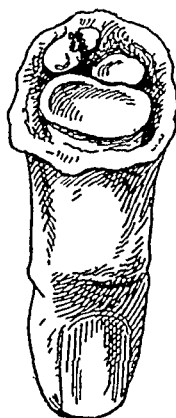


FIG 9 — Same as Fig 6

a broken sesamoid show an irregular, dentate edge on the side that corresponds to the line of fracture.

The remaining sketches (Figs 6, 7, 8 and 9) show a series of tear-fractures. Each specimen was prepared as follows. The thumb was disarticulated at its junction with the carpus. The muscles were removed without disturbing the joints. The metacarpal bone was fixed in a vise, and with a wooden mallet a blow was struck upon the front of the thumb near its tip. Not always did the sesamoid fracture, however. In some cases the phalanx, in others the metacarpal broke into or near the joint. But of the breaks obtained the four shown are fairly typical of what one might expect in the living. In these four cases the ulnar sesamoid yielded three times (Figs 6, 8 and 9) and the radial once (Fig 7). In no instance were both sesamoids broken.



FIG. 10.—Hand showing a complete set of ten sesamoids opposite the metacarpal heads. An additional sesamoid is seen opposite the head of the proximal phalanx of the thumb.



## FRACTURES OF THUMB SESAMOIDS

The removal of the muscles showed that they play no part in the fracture

Failure to detect a fractured sesamoid might be regarded as an inconsequential matter, but it must be remembered that the thumb is a very highly-specialized digit, capable of delicate and intricate movements, and that its crippling might be an affair of serious moment to a wage-earner

The treatment is by immobilization in a neutral position, and for this purpose a sodium silicate dressing, left undisturbed for four weeks, fulfils all indications. It must not be forgotten that the sesamoid, like the scaphoid, is bathed by synovial fluid, and therefore heals slowly

As to the remaining fingers, the sesamoid bones are inconstant. Citing Pfitzner, Dwight (*Variations in the Bones of the Hands and Feet*, Philadelphia, J. B. Lippincott Company, 1907, p. 11) tabulates the findings in 1440 adult hands as follows

	I	II	III	IV	V
R	99.9	48.7	1.4	0	2.1
U	100	0.1	0	0.1	82.5

In his thesis, Maas evidently overlooked this table of Pfitzner's, for he states that the radial sesamoid of the middle finger has never been observed. According to the table, the ulnar sesamoid of the middle finger and the radial sesamoid of the ring finger were not found. I chanced upon a skiagram that shows the complete set of ten, and an additional sesamoid opposite the distal interphalangeal joint of the thumb (Fig. 10). Pfitzner has observed congenital division of the ulnar sesamoid of the little finger, as well as of the radial sesamoid of the index. I have found no instance of fracture of the sesamoid bones of the fingers, but it is quite probable that examples will be reported in the future.

## ARTHROPLASTY OF THE ELBOW\*

BY ASTLEY PASTON COOPER ASHHURST, M D

OF PHILADELPHIA

I HAVE adopted arthroplasty of the elbow-joint in five patients twice for bony ankylosis, and three times for marked limitation of motion following fracture

TECHNIC OF THE OPERATION—1 *Exposure of the Joint*—The skin incision (Fig 1)<sup>1</sup> begins on the external supracondylar ridge of the humerus, about 5 cm above the joint, and is continued straight downward to the joint level where it is curved slightly backward toward the extensor surface of the forearm, its entire length is about 10 cm This incision is carried down to the supracondylar ridge above the joint, below the joint level the deep fascia is exposed but is not incised The soft parts are then cleared from the humerus the brachioradialis and the extensor carpi radialis longior are displaced forward and the triceps backward, *thoroughly* exposing the external condyle, the anterior capsule of the joint, and the external lateral ligament with the origin of the extensor muscles (Fig 2) The external condyle is then detached from the humerus by osteotome, the bone section entering the elbow-joint on the capitellar surface of the humerus In most cases even when the ulno-humeral joint is ankylosed the radio-humeral joint is free, and the external condyle may be easily turned downward on the external lateral ligament as a hinge, exposing the joint (Fig 3) If ankylosis is present between the radius and humerus it is easy to separate them by gouge without injury to the external lateral ligament In order to turn the condyle downward sufficiently to expose the joint thoroughly, the capsule must be snipped with scissors in front of and behind the external lateral ligament

2 *Dislocation of the Joint*—If ankylosis exists between the ulna and humerus these bones are separated by a suitably shaped gouge, driven transversely across the joint by smart blows from a hammer When the union has been almost completely divided, the remaining fibres on the inner side of the joint may be ruptured by abrupt, short, forceful movements of flexion and extension applied to the elbow-

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\* Read before the Philadelphia Academy of Surgery, April 5, 1915

<sup>1</sup> The accompanying illustrations (Figs 1 to 10) are from photographs of preparations in the Laboratory of Operative Surgery in the University of Pennsylvania

joint If one fears injury to the ulnar nerve a small incision may be made over its course between epitrochlea and olecranon, and the nerve may be drawn away from the bones Only in one case did I find this necessary

Ankylosis having been overcome, or in cases where no ankylosis is present, the elbow-joint is dislocated by adducting the forearm around the internal lateral ligament, as a hinge, until the forearm lies almost parallel with the upper arm, causing the ends of the humerus, radius and ulna to come into full view (Fig 4)

3 *Shaping the Bone Ends*—As little as possible is done to the ulna, especially when the head of the radius is healthy Reliance is placed on resection of the humerus for shaping the new joint (Fig 5) If ankylosis exists in the upper radio-ulnar joint it is simpler to resect the head of the radius than to turn in a flap between radius and ulna For shaping the humerus a Gigli wire saw mounted in a bow-shaped frame (the saw of Pierre Delbet) is the most convenient instrument, with this a series of cylindrical sections can be removed from the humerus until enough room is secured between the bone ends Seldom is it necessary to remove any bone above the level of attachment of the internal lateral ligament at the base of the epitrochlea

4 *Interposition of the Flap*—The bones being temporarily restored to their normal relations, the original skin incision is extended backward from its upper end across the posterior surface of the arm (Fig 6) The triangular skin flap thus outlined is raised, including a fair amount of subcutaneous fat, until the superficial surface of the triceps, or of the fat and fascia covering it, is fully exposed An interposing flap of fat and fascia is then raised from the superficial surface of the triceps, with its base at the olecranon (Fig 7) It is best to include some of the triceps aponeurosis and muscular fibres in this flap The elbow-joint is then partially dislocated again, and the flap is attached to the internal lateral ligament of the elbow, and to the anterior and posterior capsules of the joint, by a few interrupted sutures of chromicized catgut (No 0), thoroughly covering the articular surface of the humerus (Fig 8)

5 *Closure of the Wound*—The forearm is restored to its normal relation with the arm, and the external condyle is brought up in front of the pedicle of the interposing flap, and is fixed to the humerus (Fig 9) For this purpose I prefer Lambotte's self-boring screws, in the accompanying illustration a nail was employed because at the time (in the Laboratory of Operative Surgery) no such screws were at hand I have also used chromic gut and phosphor bronze wire

sutures, but have found them inferior to the Lambotte screws in obtaining secure fixation. Two screws are better than one. If much bone has been removed from the humerus, it will be necessary to trim the external condyle to fit.

The triceps is then sutured accurately to the brachioradialis and extensor muscles, the deep and superficial fasciæ are accurately approximated, and finally the skin wound is closed (Fig 10). No drainage is necessary. Interrupted chromic gut sutures (No 1 or No 2) are employed throughout. Rarely is a single ligature required.

The average time I have consumed in the operation is about one hour and thirty minutes.

#### CASE HISTORIES

CASE I—*Malunion of fracture of external condyle, limited motion and cubitus varus*. James W., aged five years. Treated in Dr Frazier's service at the Episcopal Hospital. Fractured the external condyle of his right humerus in July, 1908, and first came under my care in October, 1908, for limited motion (50 to 145 degrees) and cubitus varus (200 degrees). A skiagraph showed a fracture with outward rotation of the external condyle, but bony union. For six weeks subsequently light massage and passive movements were employed, but the range of motion improved only 10 degrees in flexion (40 to 145 degrees). Fig 11 gives a photograph taken before operation.

*Operation* (November 18, 1908).—Usual external incision. Enough of the external condyle was removed (without detaching it from the humerus) to permit full extension of the elbow, as well as to overcome the cubitus varus. The olecranon fossa on the posterior surface of the humerus was also deepened. A fatty fascial flap from the superficial surface of the triceps was turned in over the denuded external condyle and the wound closed. The elbow was dressed in hyperflexion.

At the first dressing, ten days later, the wound was healed and the skin sutures absorbed. Motion was free and painless from 45 to 90 degrees. The arm was now carried in a sling. On December 5 there was motion from 40 to 140 degrees.

In May, 1912, three years and a half after operation, the boy was presented at a meeting of the Philadelphia Academy of Surgery, exhibiting perfect function, no varus deformity, full flexion, but extension only to 150 degrees (ANNALS OF SURGERY, 1912, 11, 647). Fig 11 shows photographs made in March, 1915, more than six years since operation.

CASE II—*Malunion of fracture of lower end of humerus, limited motion and cubitus varus*. William G., aged eighteen years.

Treated in Dr Harte's service at the Orthopædic Hospital Referred by Dr E H Kistler, of Lansford, Pa When three years old this boy had fallen out of bed, landing on his left elbow He recovered with Volkmann's contracture of the forearm, cubitus varus, and limited motion in the joint (40 to 110 degrees) When first seen, August, 1912, the Volkmann's contracture caused him no inconvenience, but the limited extension in the elbow was a serious handicap in his work in the mines, and his elbow was weak from the varus deformity and pained him if he used it much Photographs made before operation (Fig 12) show the distortion of the bony points at the elbow and the limit of extension ( $\times$  indicates head of radius, the condyles and the olecranon are indicated by dots)

*Operation* (September 2, 1912) —Through the usual external incision the head of the radius, which projected far backward (Fig 13), was exposed posterior to the external lateral ligament, and was excised The external condyle was then detached, the joint luxated, and a curved section was removed from the humerus, with Butcher's saw, much more bone being removed from the radial than from the ulnar side of the humerus, so as to overcome the varus deformity Fig 14 shows the portions of bone removed, that from the humerus having been removed in three sections, until the sawn surface fitted the ulna and the varus deformity was abolished A flap of aponeurosis and muscle was secured from the triceps in the usual way The epicondyle was re-attached to the shaft of the humerus with chromic gut A drainage tube was placed at each end of the incision The tubes were removed after three days It was not necessary to have employed them The arm was dressed on a straight anterior splint, at an angle of 160 degrees

September 5 Motion from 90 to 135 degrees is easy

September 19 Out-patient Sinuses (resulting from unnecessary use of drainage tubes) have healed Motion 90 to 160 degrees is easy He carries his arm in a sling

October 3 Motion 65 to 135 degrees Ordered massage and light passive movements three times weekly

October 17 Treatment discontinued Motion 65 to 160 degrees Returns to work

July 31, 1913 Eleven months after operation the patient was again photographed (Fig 12), to show the range of motion (40 to 170 degrees) There was no cubitus varus and perfect function The elbow is stable He works on a breaker engine at the mines

CASE III —*Bony ankylosis from metastatic arthritis* Gertrude T, aged twenty-three years Treated in Dr Harte's service



at the Orthopædic Hospital In May, 1912, when about seven months pregnant, but without any evident cause (such as preceding tonsillitis, influenza, vaginitis, etc ) this patient developed an acute polyarthritis and was confined to bed for seven weeks The pregnancy terminated normally after convalescence, but the left elbow and right knee were ankylosed When first seen at the Orthopædic Hospital, in March, 1913, about ten months after this attack of arthritis, the elbow was fixed in bony ankylosis at an angle of 110 degrees, fortunately the radio-humeral joint and the upper radio-ulnar joint were not involved, as rotation in the forearm was normal

*Operation* (May 1, 1913) —Arthroplasty of elbow by usual technic A small incision was also made over the ulnar nerve and this was drawn away from the internal condyle until the bone ends were properly shaped Flap obtained from triceps as usual, and epicondyle reattached to humerus by wire suture No drain Dressed on internal right-angled splint

May 12 First dressing Inner incision healed, outer incision healed all but one spot, between two sutures at upper end, over the cavity resulting from cutting the triceps flap A little serous ooze occurred at this point Motion of 30 degrees free and painless Can get hand to mouth Arm carried in sling

May 15 Motion from 70 to 120 degrees without pain Rotation in forearm normal Can put hand to back of neck

May 23 Passive motion from 65 to 160 degrees without pain Active movement from 70 to 120 degrees Arthroplasty of the knee was done to-day (*Trans Coll Phys Phila*, 1914, xxxvi, 236), and on this account the patient had to remain in the hospital longer Fig 15 shows the condition on admission, and Figs 16 and 17 show respectively the limits of flexion and of extension in elbow and knee three months after operation Figs 18 and 19 are from skiagraphs made before and after arthroplasty of the elbow

October 17, 1914 Eighteen months after operation there was motion in the elbow from 45 to 150 degrees, there was active power of extension in the triceps, and the joint was quite stable She does all her own housework, and finds it a very useful arm

CASE IV —*Malunion of fracture of lower end of humerus, with limited motion* Benjamin F, aged fourteen years Treated in Dr Ashhurst's Orthopædic Service at the Episcopal Hospital In the summer of 1912 this boy fell on his elbow and sustained a fracture-dislocation of the type Posadas (diacondylar fracture of the humerus with forward displacement of the lower fragment and posterior dislocation of both bones of the forearm) Neither the fragments of the humerus nor the dislocation of the elbow had been reduced, and 16 months later the boy applied to the



FIG 1 —Arthroplasty of elbow, skin incision

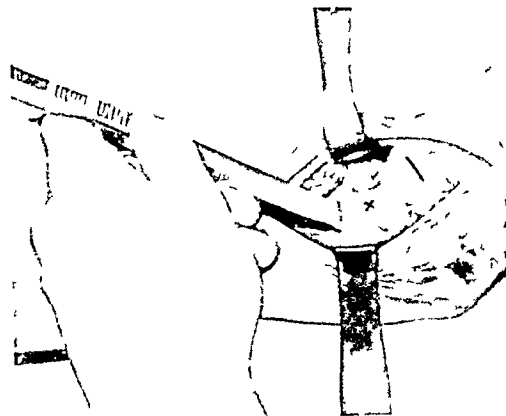


FIG 2 —Arthroplasty of elbow, external condyle (X) and head of radius (→) exposed and osteotome applied to external condyle

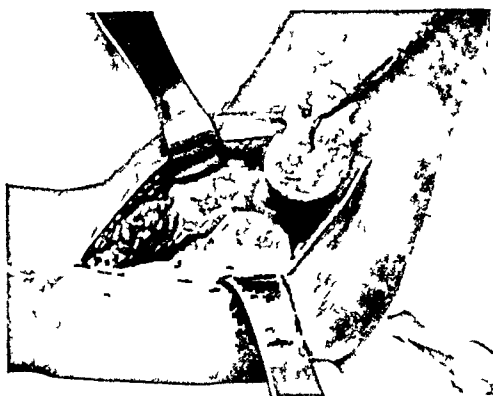


FIG 3 —Arthroplasty of elbow, external condyle turned down exposing joint



FIG 4 —Arthroplasty of elbow, joint luxated around internal lateral ligament as a hinge



FIG 5 —Arthroplasty of elbow, articulating surface of humerus removed with saw. Joint is viewed from outer side, the external supracondylar ridge and the surface from which the external condyle has been detached face the reader and the joint surface of the humerus (freshly sawn) is directed toward the right of the picture

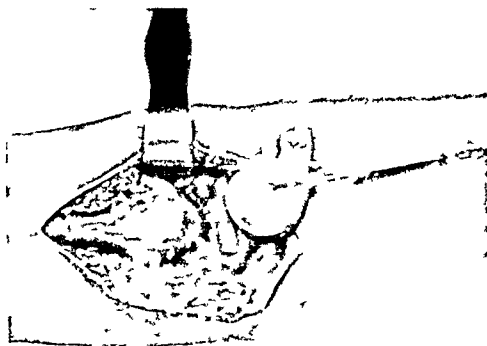


FIG 6 —Arthroplasty of elbow, bone replaced dotted line indicate extension of primary skin incision to expose triceps



FIG 7—Arthroplasty of elbow, fat and fascia pedicled flap cut from surface of triceps



FIG 8—Arthroplasty of elbow flap turned into joint covering articular surface of humerus Same view of joint as Fig 6

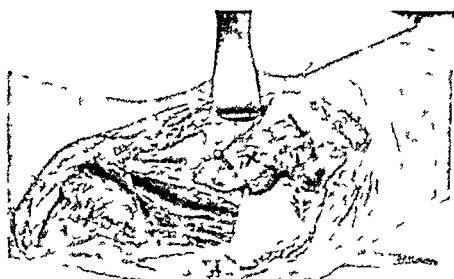


FIG 9—Arthroplasty of elbow, external condyle has been replaced and fastened by a screw or nail



FIG 10—Arthroplasty of elbow, skin sutured

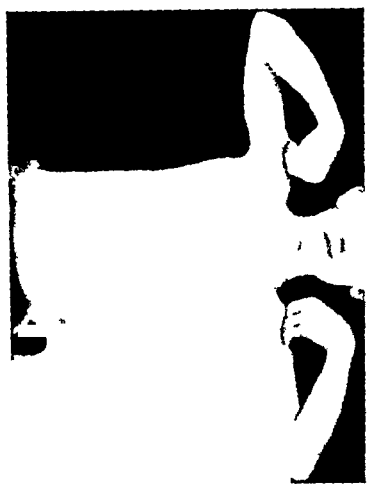
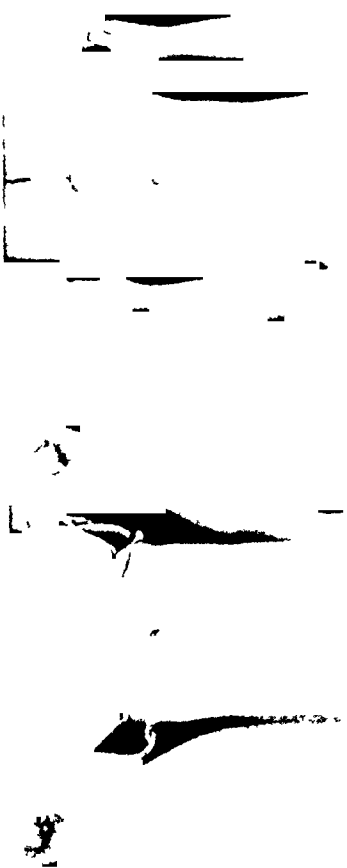


Fig 11—Case I      a is a photograph taken in 1908, just before operation showing cubitus virus      b and c are photographs taken in 1915 showing restoration of carrying angle and limits of extension and flexion



FIG. 12 —Case II The first two photographs were made before operation showing distortion of bony landmarks (X indicates head of radius) and limit of extension. The other two photographs were made eleven months after operation showing range of flexion and extension and restoration of carrying angle.



FIG 13 —Case II Skiagraph before operation, showing marked cubitus varus and limitation of extension



FIG 14 —Case II Arthroplasty of elbow, portions of humerus and head of radius excised (September 1912)



FIG 15 —Condition of Case III on admission



FIG 16 —Showing amount of possible flexion in Case III on discharge



FIG 17 —Showing amount of extension possible in Case III on discharge

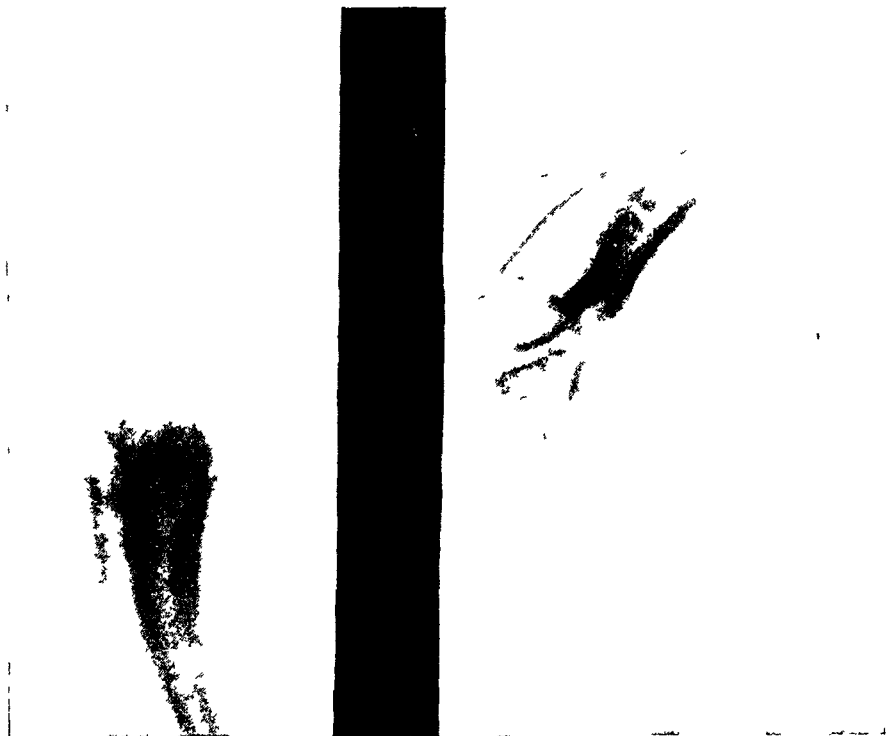


FIG 18—Case III Skiagraphs showing ankylosis of elbow before arthroplasty

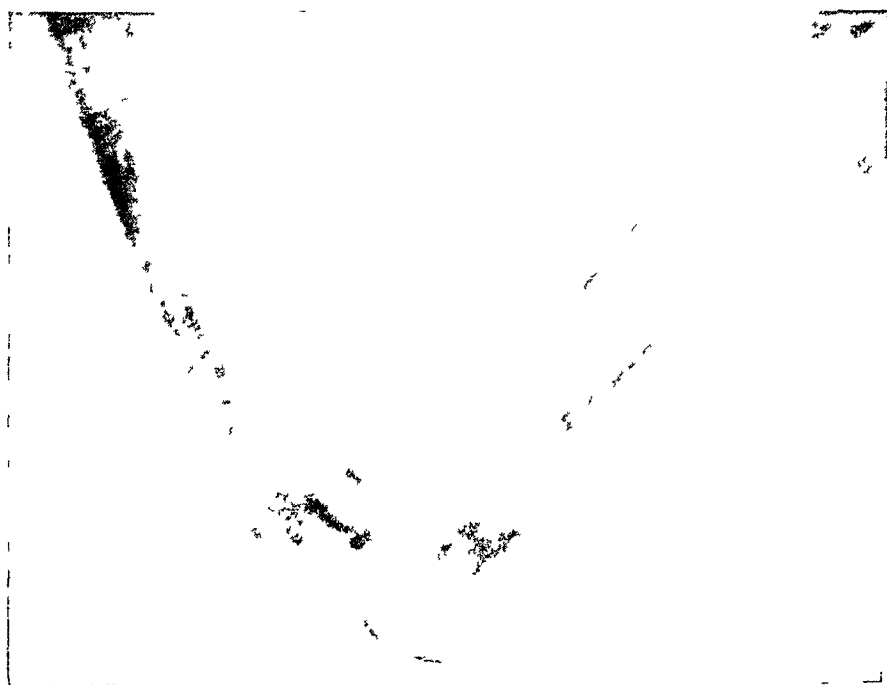


FIG 19—Case III Result of arthroplasty From skiagraph seven weeks after operation

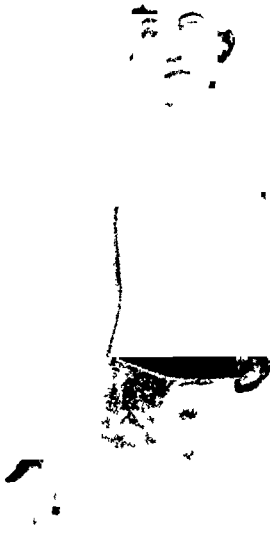
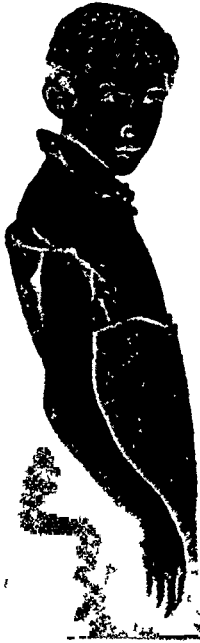


FIG. 20—Case IV. Upper photographs show limits of extension and flexion before operation. Lower photographs were made five months after operation, showing results of arthroplasty.



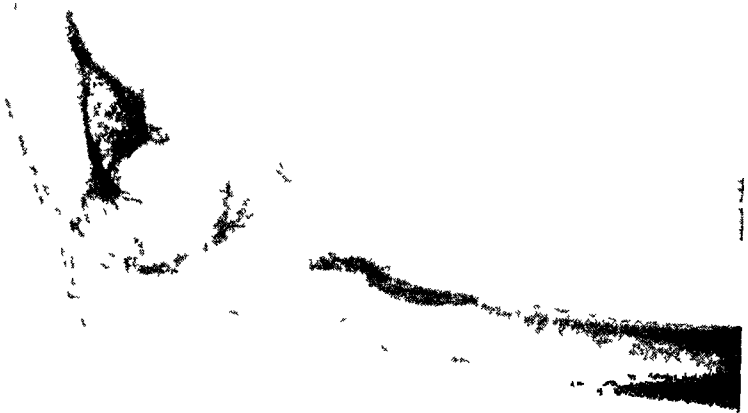


FIG 21 —Case V Skiagraph before operation showing bony ankylosis



FIG 22 —Case V Skiagraph six weeks after arthroplasty

## ARTHROPLASTY OF THE ELBOW

orthopædic department for disability from limited flexion and extension (65 to 150 degrees) (Fig 20)

*Operation* (November 26, 1913) —Arthroplasty by the usual technic After trimming the end of the humerus to proper shape with the bow-saw, it was found the ulna tended to stay in posterior luxation, so the olecranon was removed, preserving the periosteal attachments of the triceps The radial head and the greater sigmoid cavity of the ulna were not disturbed A flap from the triceps was inverted as usual, and the epicondyle was re-attached by chromic-gut sutures No drain Dressed on internal right-angled splint

November 29 Discharged from ward Skiagraph shows subluxation backward of radius and ulna

December 1 Out-patient First dressing, some sloughing of edges of skin flap turned back to expose triceps Wound is clean Elbow dressed in hyperflexion

December 15 Skin granulating well Free motion from hyperflexion to right angle Arm in sling

December 22 Motion 45 to 120 degrees Out of sling

January 5, 1914 Incision healed Motion 40 to 145 degrees

January 12 Motion 40 to 150 degrees

January 19 Motion 40 to 160 degrees

March 9 Motion 10 to 160 degrees

April 27 Five months after operation (Fig 20) Motion 10 to 180 degrees In full extension radius and ulna luxate backward There is free lateral motion in elbow, though external condyle is firmly attached to the humerus Very slight power of extension in elbow, good power in flexion

June 29 Seven months after operation Can chop wood holding axe in both hands, indicating a considerable improvement in the stability of the elbow

*CASE V—Bony ankylosis of elbow from septic arthritis*  
Sarah M., aged twenty-seven years Dr Ashhurst's service at Episcopal Hospital (orthopædic) In December, 1913, this patient suffered from a "heavy cold" with cough, she was in the habit of carrying her eighteen months' old baby on her left arm, which gradually became stiff and painful In less than a week matter formed, and an abscess on the inner side of the joint was lanced by her family physician She was admitted to Dr Frazier's service in the Episcopal Hospital on January 8, 1914, and on January 20 Dr Frazier opened the sinuses more freely and put in drainage tubes Cultures of pus at this time gave a pure growth of streptococcus pyogenes The elbow became stiff She went home in the end of February, and the sinuses were all healed early in March, 1914 Since then there has been no pain or tenderness

## ARTHROPLASTY OF THE ELBOW

Examination in May, 1914, showed ulno-humeral ankylosis at an angle of 110 degrees. She could not get her hand to her mouth, nor even to the top of her head. Rotation in the forearm was about half normal, supination being lost. Fig 21 is from a skiagraph before operation.

*Operation* (May 30, 1914) —Arthroplasty by the usual technic. All told, sections about 0.5 cm. in thickness were removed from the humerus by the mounted Gigli saw. A flap from the triceps was interposed, and the external condyle re-attached by a screw. No drain. Dressed on internal right-angled splint.

June 6 First dressing. Wound healed. Can put hand to face with ease.

June 8 Went home.

June 15 Out-patient. Motion 70 to 100 degrees. Massage ordered.

July 13 Motion 85 to 110 degrees causes pain at limits named.

August 31 Free and easy motion 90 to 120 degrees. Rotation normal. Refuses to have forceful motion under an anæsthetic. Fig 22 is from a skiagraph made six weeks after operation.

### SUMMARY OF RESULTS IN FIVE CASES OF ARTHROPLASTY OF ELBOW

Case	Before Operation			After Operation		
	Flexion	Extension	Deformity	Flexion	Extension	Deformity
I	40°	145°	Varus	35°	150°	None
II	40°	110°	Varus	40°	170°	None
III	110°	110°	Ankylosis	45°	150°	None
IV	65°	150°	Posterior dislocation	10°	180°	Posterior dislocation (only in extension)
V	110°	110°	Ankylosis	90°	120°	None

## EMPHYEMA \*

EXPLORATION OF THE THORAX WITH PRIMARY MOBILIZATION OF THE LUNG

BY HOWARD LILIENTHAL, M D  
OF NEW YORK

For many years the approved operative treatment of pyothorax has been by drainage more or less perfect through an incision with the removal of short sections of one or two ribs

Seldom has there been any effort to determine or treat the primary cause of the condition, empyema being too often regarded as itself a disease instead of as a phenomenon resulting from some other process. Doubtless we have frequently missed the superficial lung abscess, the remote septic focus or even the adjacent subdiaphragmatic infection

Also, the mechanical problems arising from adhesions and sacculations have not often been investigated on the table at the primary operation. Because of tradition we have been satisfied with unsurgical incision without proper inspection and usually with the merest pretence of digital exploration. A mortality of 25 per cent or more with about 23 per cent of secondary operations (Wilensky, *Surg, Gyn and Obst*, vol 20, No 5) and a large proportion of the cases ending in permanent fistulæ or, despite the hazard of repeated operations, in unsightly or even disabling deformities—these surely are not pleasant things to contemplate in the days of modern progress and enlightenment

And the patients often enough remain in the hospital for weeks and months, long outstaying their welcome as “interesting cases”

Lloyd (ANN OF SURG, vol xlv) has suggested the systematic exploration of the chest during the primary operation for empyema to seek the cause, the complications and the remedy of the disease. He made a long stride in the right direction when he advocated freeing the lung from its adhesions (Delorme, Fowler, Ransohoff), but he accomplished this with the help of multiple rib resection, a procedure of magnitude and danger. There is also much hemorrhage during the separation of the lung from the chest wall. His results, however (20 per cent mortality), were better than those of his predecessors

A little more than a year ago I began to study the problem of non-tuberculous suppuration within the pleura and made a preliminary announcement (*N Y Med Jour*, January 30, 1915). The present paper is to report progress after a year's work

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\* Read before the American Surgical Association, June 11, 1915

The first step was to apply a rational technic which should make possible a more accurate knowledge of the pathological anatomy of empyema in the living

In my other intrathoracic work I had noted the wonderful exposure afforded by wide rib retraction through a long intercostal incision, and I adopted this operative principle as a primary evolutionary move with the provision, however, that it might be necessary in some cases to make it actually the second step of a two-stage operation, applying the good surgical motto of "safety first"

In treating pyothorax a cure is to be striven for in the shortest time and with the fewest operations

There are two important objects (1) exploration of the pleural cavity and (2) mobilization of the lung

In critical cases a small incision between the ribs for relief only should precede the radical operation by one or by several days

*Exploration*—A transpleural incision is made in the seventh or eighth interspace close to the upper border of the rib from the angle almost or quite to the cartilage Part of the latissimus dorsi and serratus magnus muscles must be divided and in the adult such an incision may be eight or nine inches long Preferably local anæsthesia is employed up to this point, to be followed now by nitrous oxide and oxygen Ether had better be avoided, owing to the danger of irritating an already diseased lung

The mechanical rib-spreading retractor is then placed in position This instrument will widen the intercostal space to four inches or more, permitting a thorough inspection of most of the interior of the thorax The intrathoracic procedure will depend upon what is disclosed at this exploration A bulging and rigid diaphragm, for instance, may suggest a complicating subphrenic abscess and puncture here may lead to an incision and evacuation

Many other conditions might be enumerated, but for the sake of simplicity let us assume that we are dealing with a recent metapneumonic empyema or perhaps with one in which the pulmonary disease has not yet entirely abated If we suspect an active pneumonia and if a tense pyothorax urgently demands intervention a tiny intercostal incision will temporarily relieve the patient and may even permanently cure the disease The mere fact, however, that pus has been found on aspiration does not of itself mean that immediate radical operation is called for Sometimes a delay of a few days with no operation will give time for a more complete resolution of the pneumonia

Exploring in the early cases we may exceptionally find the lung truly



FIG. 1 —Rib retractor in place Knife incising pleural exudate

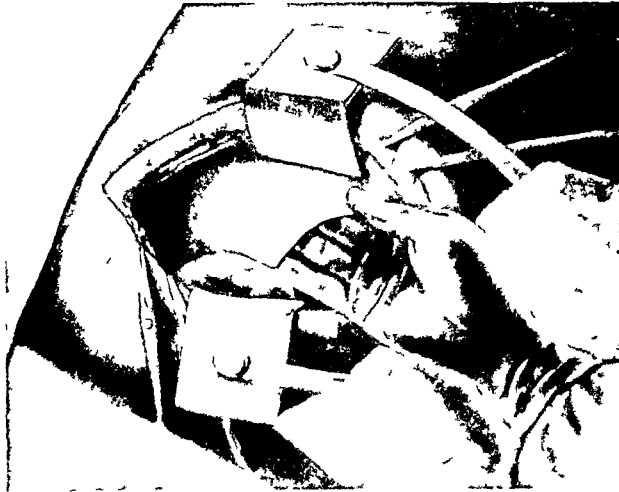


FIG. 2 —Stripping exudate from pleura Lung bulging below



FIG. 3 —Lateral incisions made with scissors Lung bulging out Port of the exudate may be cut away



free and its fissures visible. If so we need but remove the loose flakes of fibrin and close the chest in the manner to be described farther on.

Perhaps the lung is free everywhere except over the surface of the diaphragm where the lower lobe adheres. As Lloyd has noted, it may be quite difficult to mark the place where the lung and diaphragm meet. Gently peeling this adhesion away we may come upon a sacculation of pus which doubtless would have made trouble had it remained undiscovered. Or perhaps a tender adhesion toward the mediastinum covers a pocket of pus, often different in appearance and consistency from that in the general cavity.

The lobes should now be carefully separated to look for purulent collections.

Sacculations of intrapleural pus are apt to become rapidly surrounded by rigid and dense adhesions and these cavities if not evacuated early will collapse slowly or not at all. This tendency of pleural exudates to become thick and of cartilaginous rigidity forms the most cogent argument for timely lung mobilization. A description of the method follows.

*Mobilization of the Lung*—As early as ten days—perhaps sooner—after the probable beginning of the empyema it may be found on inspecting the opened chest that the pleura is covered by a grayish or greenish uniform membranous exudate which obliterates every landmark. The chest cavity may not show even a bulging to indicate the location of the lung as it lies compressed against the mediastinum, the spinal column or the chest wall. These are the cases which, treated by the old methods, would be followed by delayed healing, by fistulæ, or by contractures of the thorax.

Before proceeding to the next step all bleeding points must be secured so that the wound is dry. After wiping away the pus and loose fibrin we may incise the fibrinous coating of the pleura with the scalpel under visual guidance from near the apex to the base (Fig. 1). There should be no bleeding from this incision unless the lung itself has been superficially wounded—not a dangerous accident. Now find the plane of cleavage and carefully separate the plastic material from the viscus with the fingers, the dorsal surfaces next to the lung (see Fig. 2). When this has been accomplished as far as possible it will be necessary to make lateral deep cuts into the loosened membrane with the scissors so as to free the lung more completely (Fig. 3). The tissue is not vascular and will bleed little if any and the lung will bulge out through the opening made in its retaining membrane. Such flaps of exudate as can be easily reached may be removed.



At this point I call attention to the dangerous hemorrhage which may follow the tearing away of tough adhesions *between the lung and the chest wall*. It is therefore urged that as a rule these adhesions be not disturbed except in early cases when they are very soft. The lung mobilization will be just as well accomplished if the plastic visceral covering is peeled away, and the loose flaps of this membrane on complete expansion of the lung will later become adherent to the costal pleura. During this part of the operation sacculations, if present, will be discovered and may be evacuated.

In the left chest the pericardium must be guarded from trauma. Even during the retraction of the ribs tearing of this structure when covered by adherent thickened and inelastic membrane is a conceivable accident, though it has not occurred in any of my cases. In the low incision the diaphragm, too, may be torn by the retractor or it may be wounded in too violent efforts at freeing the lung. The rent should be repaired and a packing of gauze laid over the place.

The intrathoracic work completed, the retractor is removed, and it will be found that the ribs remain apart in the adult two inches or more. I have found it advisable not to draw them together by pericostal or percostal sutures, but merely to approximate with catgut stitches the latissimus and serratus. This will draw the ribs together to a certain degree, but not enough to interfere with drainage. The skin wound is closed with silk except at the point, usually in the midaxillary line, where drainage is to be provided. A short tube, or two or three, may be used to promote drainage but often the opening itself will suffice without tubes. The ribs will come together in from five to ten days.

*After-treatment*—Immediately after this operation some shock may be expected but in my cases it has invariably yielded to a small dose of morphine or codeine.

During convalescence the patient seems to experience greater comfort on moving about than there is when ribs have been resected. Open air treatment is of the greatest value.

It is necessary to expand the lungs by blowing exercises or by straining with the glottis closed so as to prevent the formation of sacculating adhesions, and these exercises should be begun as soon as possible after the operation. Should a sudden rise of temperature indicate retention the thorax may be explored with the finger or with a sound and evacuation secured. I have found the suction apparatus most useful in treating these patients. It should be attached to a tube draining the thorax and should be used at least half an hour at a time, twice or thrice daily. There are various forms of apparatus. I have used an electric vacuum cleaner, a water air-pump and a combined

electric pump and vacuum tank The pump and vacuum tank arranged for graduated suction has given the greatest satisfaction In Mt Sinai Hospital the apparatus is installed in one of the examining rooms and the patients are taken there for suction treatment In only one of my cases was a counterincision necessary and this might have been avoided by a more timely post-operative exploration before the adhesion had become too firm

Infection of the wound may naturally be expected in these cases This has not led to serious complications since drainage is so free

The procedure as here described is the typical method of operating, but it must not be assumed that no departure from it is to be permitted On the contrary, as in all branches of surgery, each case must be treated according to its conditions It may after all be necessary in special cases to separate tough adhesions between lung and chest wall or it may be considered wise in a given case to resect a rib What I have described is the procedure in an ordinary case My whole contention is for rational modern surgery in the treatment of thoracic empyema

After a trial of more than one year, although the number of cases is not large, I feel that I can conscientiously advocate this operation Those who have seen it and who have followed the cases have said that they were impressed by its elements of safety combined with thoroughness

I can report on but 23 cases operated upon by this method between April 27, 1914 and May 30, 1915

All of these excepting one were nontuberculous empyemata

Twenty-one were operated upon by me and two by Dr Martin W Ware

Of these 23 patients, 4 are still in the hospital but may be considered convalescent Four died, 17 per cent

Of the patients discharged from the hospital all are well excepting one—the tuberculous case which is unhealed

There were 20 one-stage operations and 3 two-stage operations None of the two-stage cases died

There have been no thoracoplasties

The oldest patient was fifty-three years old and the youngest sixteen months, the average age being about sixteen years

Bacteriology recorded in 16 cases was as follows

Staphylococcus aureus	3
Pneumococcus	8
Streptococcus hæmolyticus	4
Tuberculosis	1

## DEATHS

J P, a man of thirty-nine (Bellevue), left empyema, died of acute pneumonia of the entire right lower lobe, which came on seven days after the operation and killed in twenty-four hours

B T, a girl of three and a half years (Mt Sinai), left empyema, streptococcus hæmolyticus, died six weeks after the operation of pneumonia of the left apex

J S, a man thirty-five years of age (Mt Sinai), had gangrenous left-sided pleurisy and streptococcus pyopneumothorax and was in an almost moribund condition. Died a few hours after operation

N T, a boy aged two years (Mt Sinai), right pneumococcus empyema. Died six weeks after operation of a slow sepsis. Unfortunately no autopsy

It is, of course, impossible to draw any except the roughest conclusions from such a small number of cases. At the same time it is hoped that other surgeons may become interested so that the method may receive a wider trial

When a sufficiently large number of cases are available another report will be made by the writer with the collaboration of his associates of the First Surgical Service of Mt Sinai Hospital, Dr Joseph Wiener and Dr Martin W Ware

## BANTI'S SYMPTOM COMPLEX WITH RELATION TO SPLENECTOMY \*

BY JOHN BAPST BLAKE, M D  
OF BOSTON

SPLENECTOMY in splenic anæmia, or Banti's symptom complex, should be recommended under the following conditions

First, in adults, when the diagnosis is agreed upon by a good physician and a competent surgeon

Second, when the condition of the patient is sufficiently good to withstand what may be a very serious operation, or when a poor condition can be sufficiently improved by one or more previous transfusions

Third, in children, only after a very thorough trial of all possible medical methods of treatment, including fresh air, sunshine, careful nursing, liberal and appropriate diet, as well as the judicious exhibition of drugs. In a large majority of cases, a high white count, or a considerable recurring or continuous fever are contra-indications. In children also the agreement of physician and surgeon is an essential pre-operative requirement

Splenic anæmia is distinctly a borderline condition. In adults, most physicians of wide experience agree that it is only cured by operation, and that it is by this means permanently cured. In adults, therefore, it is not necessary to wait (except for transfusion) once the diagnosis is established. Banti's symptom complex is in most cases a slowly progressing condition, often with periods of considerable temporary improvement. In a minority of instances the disease progresses rapidly, in practically all cases it terminates fatally. Unfortunately, neither the public, nor indeed the profession taken as a whole, is convinced of the importance of the early operative attack. It is certain (as Cushing has pointed out concerning disorders of the pituitary body) that splenic anæmia is more common than at present seems to be the case, two facts contribute to explain the failure to diagnose splenic anæmia more frequently—first, the fact that the spleen must be increased to about three times its normal bulk before it can be palpated, second, the lack of a careful and exhaustive physical examination in every case of anæmia, in particular directed to the condition of the abdominal viscera. The vast majority of these cases come at first under the care,

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not of the specialist or surgeon, but of the general practitioner—and an early diagnosis is almost as important as it is in the case of cancer

On the part of the layman, it is obvious that the community is not yet educated to the idea of splenectomy for anæmia, the operation seems even more formidable than it is, the condition often not sufficiently alarming, and the symptoms not as striking and convincing as in the more acute surgical conditions—for example, appendicitis, furthermore, the mortality is distinctly higher, and probably, in spite of increasing knowledge, will remain higher. It is difficult to obtain reports of cases which die shortly after the operation. As a result of such considerations as these, the patient is usually in a condition in which a word of doubt concerning operation, or even a lack of vigor in suggesting it, causes refusal to accept the surgeon's advice. This is a very important matter and one which is incumbent upon the physician to modify, the physician has educated the patient to recognize the necessity for operation in appendicitis and gall-stones—it is now time to do similar service in all appropriate borderline cases, and for the surgeon, it is most important that too great enthusiasm does not render him less appreciative of careful indications and operative risks. We have only to recall the history of splenectomy for leukæmia to realize that one large group of the splenomegalies at first attacked vigorously, do not belong to the surgeon at all (63 deaths following 66 operations, Carstens). It is therefore essential that the patient be early prepared for the fact that medical treatment will be almost certainly unavailing, and that surgical interference is not only necessary, but that it should not be too long postponed. The writer has seen no less than four cases in the past year, all appropriate for operation, in which the patient refused. It is almost certain that these cases would have accepted operation had it been brought early to their attention, and sufficiently insisted upon by the first doctors in attendance.

There is no doubt that transfusion is a valuable aid in temporarily improving the patient's pre-operative general condition. The writer is convinced that at least twenty-four to forty-eight hours should elapse between the transfusion and the operation, the change produced by the father's blood in the child whose case history is appended, was little less than marvellous. Furthermore, it would seem that not more than ten or twelve ounces of blood is, as a rule, necessary, since the effect produced in the recipient is probably due rather to the quality than to the quantity of the blood. Although the writer has not done it, nor seen it done, there is no obvious reason why a transfusion should not be repeated in a week or ten days, if after the first the patient's condition

still seems not all that is desired to stand the operation. In the second case history appended, it might seem at first that the transfusion had some effect in precipitating the fatal intestinal hemorrhage, this was probably not true, and the occurrence of the hemorrhage at that time was purely coincidental.

In the case of children with anæmia, in association with enlarged spleen and liver, and with leucocytosis, most pediatricians are very conservative in relation to surgical measures, and probably with good reason. Not long ago a well-known professor of children's diseases remarked that he believed he had saved the lives of many such babies by not referring them to the surgeon. In his opinion almost all such cases improved and got well, the spleen returning to its normal size (or at all events to a size at which it could not be palpated) under careful nursing and feeding in the country. That not all cases react in this way is proved by Case I appended. The cases that improve under treatment, and some that do not, are regarded by this physician not as "splenic anæmia in infancy," but as disturbances of nutrition, and the prognosis is good or bad according to the blood picture, and the presence of other pathological conditions (rickets, syphilis, tuberculosis, etc.). For these reasons, the surgeon approaches children presenting conditions similar to splenic anæmia with very great caution.

The cause of Banti's complex is a most interesting and difficult problem. It is to be hoped that Yates's work in this line will soon be finished and reported in full, a preliminary note has already appeared.

Mallory in his pathology says "Banti's disease seems to be a symptom-complex resulting from partial occlusion of the splenic or portal vein, and marked obstruction to outflow of blood from the spleen, swelling and much increase of connective tissue of the organ result."

Mallory evidently believes that Warthin has proved his contention beyond question, viz. "Until it is definitely shown that splenic anæmia can exist without any evidence of obstruction in portal or splenic vein, Banti's disease and splenic anæmia must be regarded as coordinated symptom-complexes, and not individual disease-entities," and "the whole pathological picture points to an infective thrombophlebitis of portal or splenic vein as the essential feature of all these cases, no matter under what head reported (splenic or portal thrombosis, splenic anæmia or Banti's disease)."

It is certainly impossible to read Warthin's exhaustive article carefully (*International Clinics*, vol. iv, 20th Series, 1910, page 189) without sharing the conviction that his conclusions are correct. Assuming this to be the case, anything which may cause a splenic or portal throm-

bosis may be the cause of splenic anæmia, this simplifies and explains many apparently inconsistent facts we must believe that infection, whether or not we can trace it, plays the leading rôle in all cases of phlebitis, no matter where located, and that infection of all sorts may cause inflammation and thrombosis in veins, hence it becomes apparent why splenomegaly follows tuberculosis, syphilis, malaria, and pneumonia as well, and why it may also follow infection of the gall-bladder, as has recently been suggested in the Mayo Clinic Since "hypertrophy of the spleen," no matter of what origin, appears to cause in the majority of cases a diminution in red blood-cells and hæmoglobin, associated in many instances with a leucopænia (Warthin), the sequence is as follows infection causing splenic vein thrombosis, this causing hypertrophy of spleen, this causing anæmia and leucopænia, this completing the symptom-complex Splenectomy does not remove the cause, but removes an effect of the cause which had itself become a menace to life

The following three cases are reported in detail The first was entirely well when last heard from It was the most successful surgical operation which has fallen to the writer's lot to perform The second case was obviously, from the patient's report, one of great complexity, yet had an early splenectomy been accepted and performed, together with salvarsan and mercury, it would almost certainly have prolonged life considerably and probably have produced what might be called a symptomatic cure of the patient The third case is cited as one in which indication for immediate splenectomy was positive, medical treatment having already been carefully carried out Unfortunately, the patient refused operation She is, so far as is known, alive at present, but slowly losing ground

CASE I—Rose Mulliano, two and a half years old (September 27, 1913) Lymphoblastoma of spleen

*Family History*—Father and mother living and well No history of alcohol, tuberculosis or cancer One brother and one sister living and well Each had pertussis six months ago

*Personal History*—Full term normal delivery, weight at birth unknown Breast-fed 5 months Baby was well up to age of 4 months when she began to cry frequently, especially on micturition or defecation Micturition at times irregular, always painful Bowels regulated with castor oil At age of 9 months baby was taken to Lowell General Hospital where she remained seven weeks without improvement At that time the mother had noticed a mass in the abdomen and many furuncles Baby kept at home until February, 1913, when she was taken to the Lowell City Hospital

because of "very poor condition," jaundice, anasarca, ascites, large mass in abdomen, and frequent febrile attacks. Occasional attacks of marked tremor and convulsive movements limited to the hands. First tooth appeared at age of 6 months, soon followed by two more, and then no more until in Lowell City Hospital, where, between February and July, 1913, nine teeth were cut. Baby began to improve steadily after entering Lowell City Hospital, color became better, œdema disappeared, ascites went down, and mother thinks that tumor became smaller. Micturition became painless and defecation regular. On discharge from the hospital, baby began to creep and to say simple words.

*Present Illness*—Since July, 1913, following discharge from hospital, baby has again grown weak and pale. Micturition irregular and painful, defecation very painful, appetite poor, stools at times watery, green to black in color. Baby sleeps poorly.

*Physical Examination*—Fairly developed and nourished. Pale. No dyspnoea or cyanosis. Not acutely sick. No evidence of pain. Fontanelles closed. Frontal eminences somewhat prominent. Radial epiphyses large, slight rosary. No Harrison's groove. Spinal column in normal alignment. Slight outward bowing of tibiae. Ears, eyes and nose negative. Mouth high narrow palatal arch. Teeth 6/6, in good condition. Throat and neck negative. Lymph-nodes no general enlargement. Few small glands 5 cm in diameter in cervical triangles and in groins. Heart and lungs negative. Abdomen slightly protuberant, liver dulness from fourth interspace to  $2\frac{1}{2}$  cm below costal margin in right midclavicular line. In left upper quadrant is a palpable, firm mass with a definite sharp edge, freely movable, extending from a short distance above costal border well around towards spine, it fills most of left upper quadrant, and near the umbilicus it extends somewhat into right lower quadrant. Right half of abdomen is soft and tympanitic. Extremities and skin negative.

Blood examination. Hæmoglobin 45 per cent, white blood-cells, 6,600, red blood-cells, 2,496,000.

Urine shows many pus cells. Child is comfortable. Seen in consultation by all medical services, who agree that tumor is spleen. Stool negative. X-ray plates show tumor is spleen.

October 3 Wassermann negative. October 7 Patient cries when passing urine. Movements occasionally foul, well-formed, brown, with small amount of mucus. October 19 Hæmoglobin 40 per cent. Blood examination. White blood-cells, 6,000. Smear polymorphonuclears, 31 per cent, lymphocytes, 60 per cent, mononuclears, 8 per cent, eosinophiles, 1 per cent, 4 normoblasts. *Patient transferred to first surgical service*. October 28 Transfusion was done under ether, causing improve-



ment in condition and in color October 29 Splenectomy, spleen was found to be free from adhesions, pedicle clamped and cut Good ether recovery Patient made uneventful convalescence and was *transferred to first medical service* November 29 General condition excellent Gaining weight and strength Is fast learning to talk December 5 Hæmoglobin, 70 per cent, white blood-cells, 9,200, red blood-cells, 2,900,000 Smear polymorphonuclears, 44 per cent, lymphocytes, 29 per cent, small mononuclears, 22 per cent, transitional cells, 5 per cent December 16 Hæmoglobin, 70 per cent, white blood-cells, 6,500, red blood-cells, 3,800,000 December 19 Hæmoglobin, 70 per cent, white blood-cells, 6,500, red blood-cells, 3,800,000 Smear shows polymorphonuclears 65 per cent, large lymphocytes 10 per cent, small lymphocytes 16 per cent, myelocytes 9 per cent January 3, 1914 Smear polymorphonuclears, 39 per cent, lymphocytes, 59 per cent, myelocytes, 2 per cent February 2 General condition has been excellent Discharged well to mother

CASE II—Warren Mulrey, aged forty-seven, brass worker, married (October 23, 1913) Splenomegaly

*Family History*—Negative No cancer

*Personal History*—Does not remember any diseases of childhood Twenty years ago "rheumatism," joints were swollen and tender, had some fever and since then has had mild pains in all joints Seventeen years ago syphilis Formerly used alcohol to excess, but for past three years has used very little, averaging 3 glasses of beer a day

*Present Illness*—Felt perfectly well up to three years ago when one day at work he suddenly felt dizzy and weak, had fulness in the epigastrium and within a few minutes vomited much black material Went to Relief Station and from there was sent home, where he stayed in bed four days He was advised by his physician to omit all alcohol Since then he has had two similar attacks but has not vomited He has noticed black stools following each attack On October 19 he felt suddenly weak and dizzy, had a "cold sweat," passed some black stools the stools contained fresh blood He had no vomiting at that time and felt fairly well up to October 22, when he had another "giddy attack" and vomited about one pint of fresh blood He thinks he has lost 20 pounds in the last three years Appetite fair, no history of "indigestion," has found it increasingly difficult during past three years to do his work

*Physical Examination*—Fairly developed and nourished, pale, no dyspnoea or cyanosis Eyes, ears, nose, throat negative No general glandular enlargement Heart and lungs negative Abdomen soft, level and tympanitic Liver 2 cm below costal

margin In the left upper quadrant is a smooth, oval tumor moving with inspiration to level of umbilicus, no tenderness or spasm  
Extremities negative

Hæmoglobin, 65 per cent, white blood-cells, 8,000, red blood-cells, 3,700,000 Urine negative Stools black, no fresh blood, but benzidine test positive, Wassermann reaction + + +

October 27 Patient put on potassium iodide grs xv t i d and proto-iodide of mercury gr  $\frac{1}{6}$  t i d Patient has had no hemorrhage October 31 Patient given neosalvarsan 45 gm intravenously November 3 Seen in consultation by Dr Libby, who suggests gumma of spleen Physician considers possibility of new growth November 6 Patient complains of occasional dull pain in right upper quadrant Eats well Tumor unchanged November 7 Neosalvarsan 9 gm followed by slight reaction November 11 Oxycyanate of mercury intramuscularly November 14 Neosalvarsan 9 gm November 17 Seen by First Surgical Service with question of splenectomy, which was recommended unless immediate improvement obtained November 21 Neosalvarsan 6 gm Blood examination Color index, 13/11, red blood-cells, 2,676,000, white blood-cells, 5,200 A loss of 1,000,000 reds since entrance Wassermann still + + + General condition unchanged Rectal examination negative December 3. Seen by Dr Joslin who advises continuation of present treatment with addition of iron (Blaud pills) Blood examination red blood-cells, 1,808,000, white blood-cells, 4,200, hæmoglobin, 55 per cent December 10 Blood examination red blood-cells, 1,767,000, white blood-cells, 4,000, hæmoglobin, 55 per cent December 15 Blood examination red blood-cells, 2,400,000, white blood-cells, 4,600, hæmoglobin, 65 per cent December 23 Patient's condition unchanged General condition is good Spleen is not decreased in size Has had no hemorrhage Desires to go home

Patient returned to hospital in February to have splenectomy performed, stating that since his discharge he has had increasing weakness and pallor, but gives no definite history of a hemorrhage Was kept in bed for several days in preparation for operation His son gave blood for transfusion, but patient died in three days following transfusion from severe hemorrhage, vomiting much fresh blood and passing large amounts of blood by rectum

*Anatomical Diagnosis*—Œsophageal varices and hemorrhage, anæmia, congestion of lungs, sclerosis of liver, chronic nephritis, chronic passive congestion of spleen, obliterative fibrous pleuritis, arteriosclerosis, chronic fibrous localized peritonitis, hydrothorax, ascites, chronic fibrous perihepatitis, chronic fibrous perisplenitis, chronic fibrous pleuritis, chronic periostitis

of tibia, sclerosis of testis, scar at base of penis, scars on shins, Mural thrombus of portal vein, osteoporosis of calvarium

CASE III—Female, aged thirty-four, housework, married (November 27, 1913) Splenic anæmia

*Family History*—Negative

*Personal History*—Negative No alcohol

*Present Illness*—Patient states that about two months ago she began to have severe headache, trouble with her eyes, frequent urination and felt badly all over. Noticed that her feet and ankles began to swell. The swelling spread up to her knees. Finally her abdomen became distended. Has had some nausea, but no vomiting. Has steady abdominal pain in left upper quadrant. For past two months bowels have moved three to four times a day, movements are watery in character. Has had attack of vertigo. No other symptoms obtainable.

Admission diagnosis chronic diffuse nephritis

*Physical Examination*—Well developed and fairly well nourished. Eyes, ears, nose and throat negative. Heart 1 x 14 cm, action regular, systolic murmur over entire præcordia, loudest at second left interspace, transmitted to neck, faint diastolic murmur heard in third left interspace. Pulses regular, equal, fair volume and tension. Lungs dulness at both bases and at left apex and front. Many fine and medium moist râles at bases. Few fine râles over apices in back. Abdomen very prominent. Liver and spleen easily palpable, markedly enlarged, especially the spleen. Extremities marked œdema of feet and legs.

Urine examination negative

Wassermann reaction negative

Systolic blood-pressure 138 mm

Blood examination Hæmoglobin, 35 per cent, white blood-cells, 4,800, red blood-cells, 3,200,000. Smear shows marked achromia moderate variation in size, no normoblasts seen. Differential count polymorphonuclears, 62 per cent, mononuclears, 38 per cent.

*Treatment*—Restrict fluids, chronic nephritis diet, salts oz 2 every A.M., tincture citrochloride of iron ℥ 10 t.i.d. p.c., strychnine gr 1/100 t.i.d. a.c.

December 5 General condition improving. Œdema disappearing. Hæmoglobin, 35 per cent. December 14 Blood examination hæmoglobin, 45 per cent, red blood-cells, 2,720,000. Smears as before. Differential polymorphonuclears, 66 per cent, mononuclears, 32 per cent, eosinophiles, 2 per cent.

Treatment Fowler's solution ℥ 5 and increase ℥ 1 daily. December 24 Blood examination hæmoglobin, 45 per cent, red blood-cells, 2,500,000. Smears show 1 questionable normoblast.

## BANTI'S SYMPTOM COMPLEX SPLENECTOMY

Polymorphonuclears, 64 per cent , mononuclears, 35 per cent , eosinophiles, 1 per cent Splenectomy recommended and refused

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# CHRONIC INTESTINAL STASIS AS PRODUCED BY OBSTRUCTION AT THE ILEOCÆCAL REGION AND AT THE HEPATIC FLEXURE \*

WITH REPORT OF NINETEEN CASES

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CHRONIC intestinal stasis is a condition of chronic obstruction with stagnation of the intestinal contents resulting in an excessive production of toxic material, the absorption of which leads to a chronic poisoning of the entire organism.

Until comparatively recent years this condition was known as "chronic intestinal auto-intoxication," or "chronic intestinal toxæmia," the obstructive element being entirely overlooked. It was reserved to Sir W. Arbuthnot Lane to point out that practically all cases of chronic intestinal poisoning are due to purely mechanical causes and that such mechanical causes may be removed or corrected by appropriate surgical measures.

It has been shown by Lane, Jackson, Bainbridge, and others, that this mechanical obstruction is produced by various adventitious bands and membranes, concerning the etiology of which a number of theories have been advanced.

The most commonly accepted of these theories are the evolutionary theory of Lane, the congenital theory of Reid, Mayo, and others, and the inflammatory theory of Pilcher. Whatever may be their origin there is no doubt that these adventitious bands and membranes are of very frequent occurrence and are the cause of a great deal of suffering and ill health, if not of even much more serious consequences.

A very large percentage of all cases of chronic intestinal stasis are due to obstructions of the intestine at two points, namely, at or near the ileocæcal valve and at or near the hepatic flexure of the colon.

In the ileocæcal region the obstruction may be due to a Lane's kink, to an adherent appendix, to an unduly developed ligament of Treves with fixation of the appendix, to gross adhesions involving small intestine, cæcum, and omentum, and perhaps to incompetency of the ileocæcal valve. Obstruction in the ascending colon or at the hepatic

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## CHRONIC INTESTINAL STASIS

flexure may be due to a Jackson's membrane or to angulation of the flexure by a membrane binding together the ascending and transverse colons. A freely movable and prolapsed cæcum will tend to increase any coexisting obstruction and may in itself be the cause of stasis.

Not infrequently a combination of these conditions is present in any given case.

Membranes and bands attached to the splenic flexure and sigmoid have been described by Lane, Bainbridge, and others. Such conditions must be uncommon, at least in the male. In a series of nineteen cases coming to operation during the past year and in another series of nine cases previously observed (*ANNALS OF SURGERY*, January, 1914) in not one were obstructive symptoms present in either of these localities and in none was there a membrane or band found at the splenic flexure or pelvic colon (sigmoid) at operation.

A Lane's kink is an angulation or kinking of the terminal ileum by a band of peritoneum which extends from the parietal peritoneum of the right iliac fossa, usually that overlying the iliac vessels, to the wall of the intestine at a point within five or six inches of the ileocæcal valve.

Jackson's membrane is a thin, transparent, veil-like membrane which arises from the parietal peritoneum, to the outer side of the ascending colon, passes over the colon and hepatic flexure, and loses itself in the wall of the gut near its mesenteric attachment. Numerous fine blood-vessels course through this membrane, in direction from above downward and inward, which vessels bleed rather freely upon being cut. In this membrane there are a number of thickened bands of fibrous tissue which follow the course of the blood-vessels. Such bands may improperly fix and angulate the hepatic flexure, thus producing obstruction. In other cases one or more such bands will be seen passing across the ascending colon directly compressing it and causing obstruction. In still other cases the membrane will bind together the ascending and transverse colons, thus producing a kinking and obstruction at the hepatic flexure. The extent of this membrane is variable.

Angulation at the hepatic flexure may also be caused by a thick membranous layer of adhesions which binds together the last few inches of the ascending colon and the first few inches of the transverse colon. This membrane does not arise from the parietal peritoneum as is the case with Jackson's membrane, but is limited to the colon and seems to be a separate entity.

An appendix adherent to the under surface of the ileal mesentery,



whether its tip be attached to the wall of the gut or not, may cause obstruction by shortening the mesentery along the line of its attachment, thus producing a condition similar to Lane's kink. In some cases the attached appendix seems to form a part of an ileopelvic band. In other cases numerous small filaments extend from the tip of the appendix to the wall of the ileum.

Multiple adhesions following acute inflammation or operation produce various kinkings, angulations, and deformities of the ileum or cæcum, bringing about obstruction of greater or less degree. Not infrequently omental adhesions are the sole cause of the obstruction, either by directly compressing the gut or by becoming attached to it and thus making a fixed point of support.

The symptoms of chronic intestinal stasis as produced by the causes above enumerated are

First, attacks of abdominal pain, which are usually referred to the epigastrium or right iliac region and which may or may not be accompanied or followed by vomiting. Such attacks are not associated with the taking of food.

Second, local tenderness which is practically confined to two areas, that of the right iliac region and the region of the hepatic flexure. The point of maximum tenderness in the right iliac region is usually somewhat below and internal to the point of greatest tenderness in appendicitis. In several cases in which the appendix lay to the outer side of the cæcum, the point of maximum tenderness was well to the inner side of and below McBurney's point, indicating that the tenderness was produced by the band or kink and not by the appendix. In other cases in which the appendix had been removed at a previous operation, the tender area lay directly over the ileopelvic band, which was the cause of the symptoms for which the second operation was done.

Third, constipation which is a marked feature in a majority of the cases. Constipation often precedes the attacks of abdominal pain by a considerable period. Not infrequently constipation alternates with a mucous diarrhœa.

Fourth, a sensation of distention by gas, often limited to the right side of the abdomen. Not infrequently the distended cæcum and ascending colon can be plainly felt.

Fifth, symptoms of intestinal auto-intoxication. Such symptoms are a feeling of general ill-being, a lack of energy, headache, backache, and loss of appetite. The conditions are described by our patients as "feeling dopey all the time." There is usually a sallow, muddy complexion, with rings beneath the eyes. The skin may be blotchy or

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spotted and the breath very offensive Not infrequently neurasthenic symptoms develop There is quite commonly a very considerable loss in weight

Sixth, in addition to the above symptoms the most important diagnostic sign is stagnation of bismuth at certain points in the intestinal canal as shown by radiographs after a bismuth meal

The symptoms of intestinal stasis may be further divided into *obstructive* and *toxic* In the former there may be very severe attacks of abdominal pain, often referred to the epigastrium, and frequent attacks of vomiting In the latter the symptoms of intestinal auto-intoxication predominate In some cases the toxic symptoms entirely overshadow the obstructive, but careful questioning will usually bring out a history of attacks of abdominal pain In such cases there are practically always present the areas of local tenderness above referred to

The treatment of chronic intestinal stasis may be either medicinal, mechanical, or operative Very often a combination of these methods is employed

In early and mild cases a careful regulation of the diet and the administration of Russian mineral oil (liquid petrolatum) may suffice In more advanced cases these measures, combined with the application of a supporting belt or mechanical spring support may entirely relieve the symptoms In the majority of cases, however, in which the symptoms are well marked operative procedures are necessary Such operative procedures consist of a free abdominal incision, either through the fibres of the right rectus or by displacing this muscle to the outer or inner side The ileocæcal region and that of the hepatic flexure are then carefully explored An ileopelvic band, if present, is divided transversely and the margins of the denuded area thus produced are united by suture in a line at right angles to that in which the band was divided Very often considerable undermining of the peritoneum is necessary to entirely correct the angulation of the ileum produced by the band, but it is remarkable what very marked kinking and obstruction may be entirely relieved by this procedure Not infrequently the ileum is markedly dilated proximal to the point of attachment of the band, and its contents can be "milked" past this point only with some difficulty When the band has been freely divided it can be demonstrated that the obstruction has been entirely relieved

In those cases in which the band is attached by its extremities only simple division of the band will relieve the obstruction Rarely two

distinct bands are present, both of which have to be divided transversely and the denuded areas sutured longitudinally

Very often the simple removal of an adherent appendix will correct the angulation and obstruction. In those cases in which there is an ileopelvic band together with an adherent appendix, the band will naturally have to be divided in addition to the removal of the appendix.

In cases in which obstruction is produced by a ligament of Treves attached to the mesentery of an adherent appendix, the removal of the appendix by releasing the ligament will relieve the obstruction.

In those very common cases of obstruction resulting from omental and intestinal adhesions, the treatment consists of a very careful separation of the adhesions with division of the omentum where necessary and a thorough covering in of all denuded surfaces thus produced. Any raw surfaces that may be left after this procedure and all suture lines are liberally smeared with sterilized vaseline. Omental grafts may be employed to cover extensive peritoneal defects.

Obstruction in the ascending colon or at the hepatic flexure by a Jackson's membrane is corrected by dividing this membrane at such points as it is seen to be the cause of the obstruction, paying especial attention to the fibrous bands. In some of these cases the defects in the membrane thus produced may be corrected by uniting the margins of the opening in the membrane at right angles to the line of division. In those cases in which the ascending and transverse colons are united by Jackson's membrane or by the somewhat limited membranous formation above described, the conditions must be fully corrected by complete division of this restricting membrane.

In other cases, in which the membrane envelops the ascending colon and hepatic flexure and even the transverse colon as if these structures were contained in a membranous bag, the membrane must be fully divided to such an extent as is necessary to completely correct any angulation or obstruction.

In all cases the margins of the divided membranes are well covered with vaseline to prevent subsequent adhesions.

In not a few cases of obstruction and stasis the cæcum is unduly movable and prolapsed. This is the condition described by Wilms as "cæcum mobile," which may be remedied by uniting the external longitudinal band of the cæcum to the lateral abdominal wall, by two or three interrupted sutures.

It may be noted that the more radical operative procedures of short circuiting or colectomy have not been mentioned in the above discussion. In not one of twenty cases of chronic intestinal stasis operated

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upon during the past year did such measures seem indicated. Eighteen of the twenty cases were markedly improved or entirely cured by the operative measures above outlined and were restored to active service in the Navy. In one case the patient was of the opinion that he had not been benefited by the operation. His general appearance, however, was decidedly improved and he was returned to duty. In another case very marked improvement followed the cutting of a Lane's band which was maintained for about three months. At the end of this period symptoms suggestive of ulcer of the stomach appeared, and, as the patient declined further operation, he was ultimately discharged from the Service. His condition however at the time of his discharge was very much better than when admitted.

It may be remarked in passing that the ability of an enlisted man in the navy to perform his duties on a sea-going ship is a rather severe test as to the character of the results obtained.

In the majority of these cases the effects of the operation are almost immediate and very marked. Often in a month's time the skin will have become clear, constipation will have disappeared, the patient will have begun to take on weight and will inform you that he feels like a "new man." In cases in which vomiting is a marked feature this symptom will disappear almost immediately. In all these cases, in fact, vomiting did not recur after the patient had recovered from the immediate effects of the operation.

As to the more remote results it may be mentioned that in one case the patient gained twenty-four pounds in eight months, in another, nineteen pounds in six months, and in many other cases the results were almost as striking.

The question as to the permanency of the cure in these cases is one of very great interest. It is contended by those who advocate the short circuiting and colectomy operations in all cases that the bands and membranes will ultimately reform and reproduce the obstructive conditions. We have, however, traced several cases for a year and a half now (which cases were published in a previous communication,<sup>1</sup>) and these patients have remained in excellent health, and have had no return of their stasis symptoms. Nevertheless it seems unquestionably true that in a very small percentage of late cases, such as certain cases in which the cæcum and ascending colon are very large and freely movable, in which the transverse colon is prolapsed, in which the obstruction can be demonstrated at the splenic flexure or in the

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<sup>1</sup> ANNALS OF SURGERY, January, 1914.

sigmoid, such operations as colectomy or short circuiting seem to offer the only hope of a permanent cure. I have seen several of these late cases with Bambridge of New York, in which colectomy or short circuiting was done by him with very gratifying results. However, cases in which these radical procedures are necessary I believe are the rare exception. In none of twenty-five cases operated during the past two years did a short circuiting or colectomy seem indicated. A complete cure or great improvement occurred in practically all these cases, operated according to the conservative methods above outlined.

## REPORT OF CASES

CASE I—L C A, age twenty-four years. Admitted December 5, 1913.

History of first attack of abdominal pain, eleven years ago, diagnosed appendicitis, and of five or six attacks of cramps with localized right iliac tenderness since that date. For the past year or more there has been marked constipation with occasional attacks of diarrhoea. Has had frequent headaches and has felt listless, dull, and heavy. A thin, tired-looking man with a muddy, sallow complexion. Examination shows moderate tenderness in the right iliac region and more marked tenderness over the hepatic flexure. Radiographs show marked stagnation of bismuth in the ascending colon.

*Operation* (December 24, 1913)—Gas-ether, right rectus incision. A thickened appendix removed and stump inverted. At the hepatic flexure there was a rather limited Jackson's membrane, which was causing marked angulation and obstruction. This was divided transversely and sutured longitudinally.

February 10, 1914. Discharged. Headache, malaise, and local tenderness have disappeared. Bowels move once daily without purgatives. A note from this patient on August 10, 1914, seven and one-half months after operation, stated that he had gained twenty-four pounds in weight and felt better in every way.

CASE II—T M, age twenty-one years. Admitted December 30, 1913.

History. A year before admission had an attack of epigastric pain and frequent vomiting lasting two weeks or more. Six weeks before admission had epigastric pain increasing in severity for four days, when vomiting commenced and recurred once or more each day until he was admitted. Since admission he has vomited frequently, practically whenever food was taken. Examination shows marked tenderness over the appendix and less marked in the epigastrium. Bismuth radiograph shows large part of the bismuth meal in the terminal ileum at the end of nine hours.

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*Operation* (January 6, 1914) —A thickened and indurated appendix was removed and a typical ileopelvic band causing marked angulations of ileum was divided transversely and united longitudinally. Uninterrupted recovery. Did not vomit after operation.

This patient was last seen on October 12, 1914. He had gained in weight and looked well. There was, however, pain after meals and other symptoms strongly suggestive of ulcer. He declined further operation and was discharged from the Service.

CASE III —L. T., aged forty-two years. Admitted December 30, 1914.

History that six years ago he had an attack of epigastric pain, vomiting, and constipation, lasting two months. Since this time such an attack would occur every four or five months. Constipation a marked feature throughout. For two weeks before admission he had vomited repeatedly and had taken no food. On admission examination showed tenderness over the appendix region and to a much less degree in the epigastrium. By January 5, vomiting had ceased and the tenderness was more localized over the appendix area.

January 20. Radiograph shows marked nine hours stasis in terminal ileum.

January 26. On opening the abdomen the appendix was found to be thickened and firmly adherent to the under surface of the mesentery of the ileum, causing a marked angulation of ileum about two inches from ileocaecal valve. The removal of the appendix corrected this condition.

February 27. Greatly improved. No vomiting or pain since operation. Bowels moving regularly without purgatives. Has gained ten pounds. Discharged.

CASE IV —C. C., aged twenty-three years. Admitted February 9, 1914.

History. December 6, 1914, pus appendix drained, appendix not removed. Appendix removed March, 1914. Since this date there have been frequent attacks of abdominal pain referred to the appendix region with occasional vomiting.

Bismuth radiograph shows stagnation of bismuth in terminal coils of the ileum at the end of nine hours.

*Operation* (February 16, 1914) —Right rectus incision through scar of former operation. Adhesion of omentum and of ileum to caecum separated, raw surfaces covered in and smeared with vaseline.

March 27. Discharged. All symptoms relieved.

CASE V —A. L. D., aged thirty years. Admitted February 27, 1914.

History Trouble began rather acutely five and one-half years ago with vomiting on arising in the morning and after each meal Following such attack there would be epigastric pain Since the outset of the trouble there has been very marked constipation requiring daily purgatives, and he has lost weight (from 190 to 130 pounds)

On admission complexion ruddy, weight 135 pounds There is a marked tenderness over the appendix region with slight tenderness in epigastrium

Bismuth radiograph (Fig 1) shows marked nine-hour stagnation in terminal coils of ileum with puddling The kink is plainly to be seen in the radiograph Was kept under observation for two weeks during which time he vomited several times a day This was accompanied with marked constipation At operation, an appendix, long and free, with no evidence of inflammation, was removed A short and thick ileopelvic band bound the ileum, at a point about two inches from the valve, to the right iliac fossa, so that the gut could not be lifted from the fossa for a distance of more than one inch This was divided transversely and sutured longitudinally

May 1 Recovery was uneventful All symptoms relieved Bowels move regularly without purgatives Radiograph (Fig 2) taken nine hours after a bismuth meal shows the head of the column has reached the rectum No bismuth in terminal coils of ileum Six months after operation patient was examined He had gained fifteen pounds and his bowels were moving naturally once daily Vomiting had occurred but once or twice since the operation, and then probably due to some indiscretion of diet

CASE VI—F J, aged thirty-four years and six months Admitted March 13, 1914

Present trouble began eight years ago with gradually developing pain in "pit of stomach" and constipation Has had attacks of epigastric pain and marked constipation since this time, requiring purgatives three to four times a week There have been intervals of a week or two when there was no pain Vomiting occurred frequently, sometimes several times a day, and at such times constipation was marked When the bowels would move there would be no vomiting Has lost about ten pounds since trouble started About half the time felt "dopey" and without energy

Examination Fairly well developed, sallow man Abdominal palpation shows tenderness in epigastrium to right of midline and over appendix region Most marked at the latter point

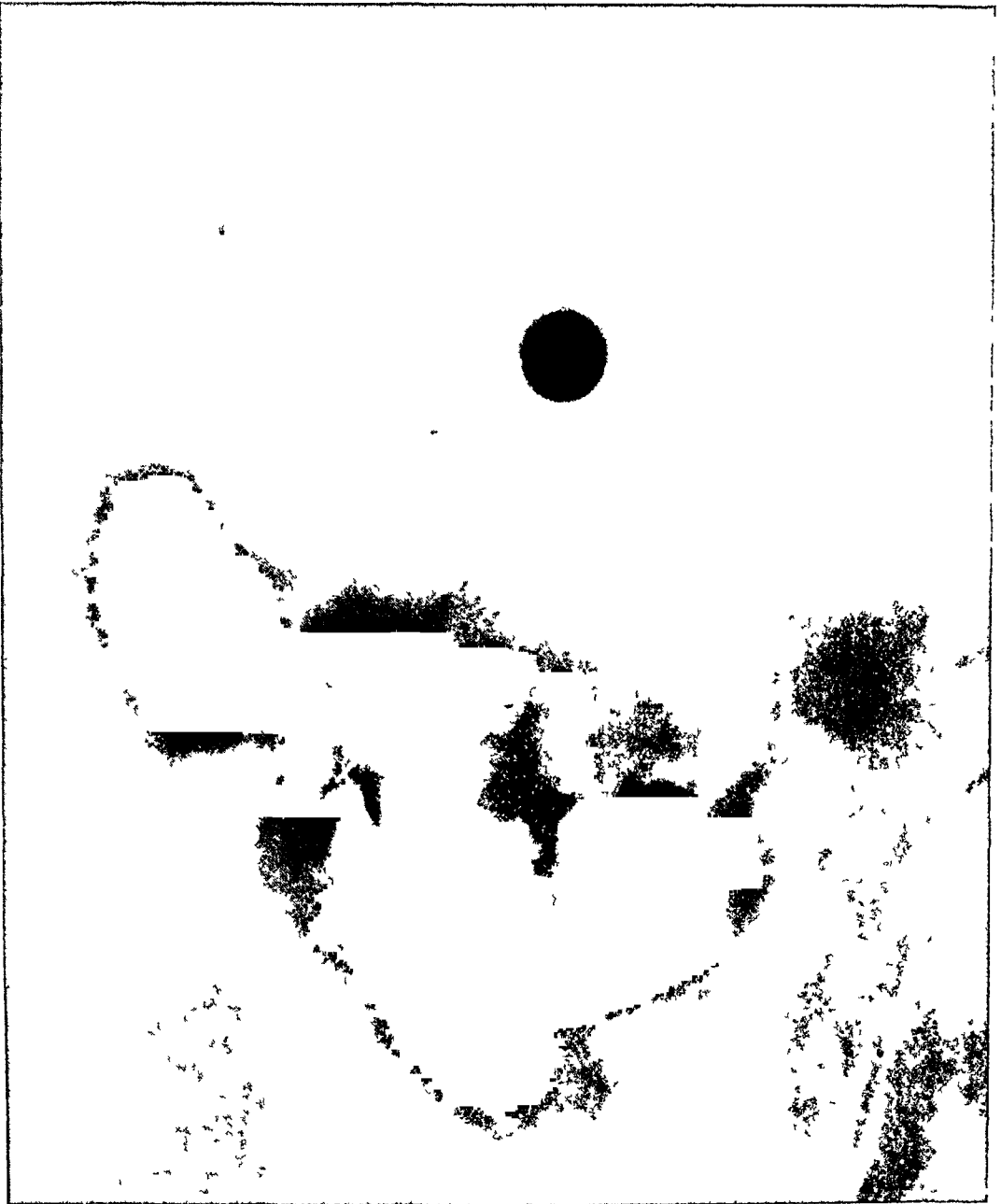


FIG 1 —Case V. Radiograph nine hours after bismuth meal showing ileal stasis with puddling, kink at point X. At operation unusually well developed Lane's kink.





FIG 2 —Case V Same after operation Radiograph taken nine hours after bismuth meal shows that the obstruction has been entirely removed



FIG 3—Case XII Plate 7 Radiograph taken nine hours after bismuth meal showing ileal stasis and puddling At operation Lane's kink Ileopelvic band attached at the point marked Y



FIG 4—Case XV Plate 11 Radiograph taken twelve hours after bismuth meal showing obstruction at hepatic flexure At operation Lane's kink and Jackson's membrane Obstruction in terminal ileum and at hepatic flexure

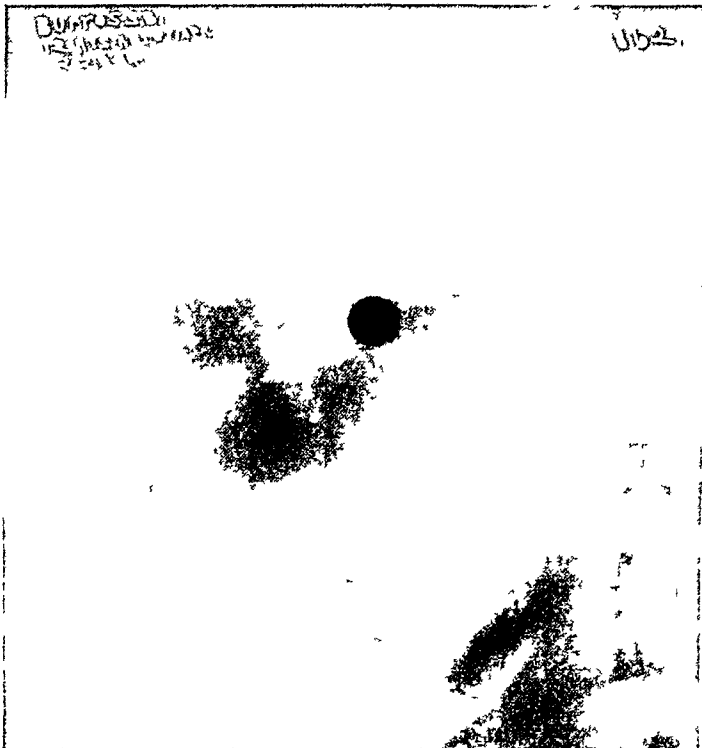


FIG 5—Case XV Plate 12 After operation Radiograph taken twelve hours after bismuth meal showing that obstruction at the hepatic flexure has been relieved Head of bismuth column has reached the sigmoid very small amount of bismuth still present in terminal coils of ileum

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Pain never referred to the appendix Radiograph shows stagnation of bismuth in terminal coils of the ileum after nine hours

*Operation* (March 30) —The appendix was found to be somewhat thickened and adherent to the under surface of the mesentery It was removed A well-marked Treves' ligament was present which evidently caused angulation of the ileum within an inch of the ileocæcal valve

April 16 Discharged Bowels move daily without purgatives There has been no vomiting since operation Has gained fifteen pounds

CASE VII —K H, aged twenty-four years and six months Admitted March 25, 1914

Present trouble began about two years ago with constipation and attacks of dull epigastric pain relieved by purgatives This condition has grown steadily worse During the past six months there have been three of these attacks with quite severe epigastric pain There has been occasional headache during this period and periods of a "dopey," "good-for-nothing" feeling On admission a well-developed, well-muscled man, complexion sallow At present complains of slight epigastric pain and constipation Examination shows slight tenderness in epigastrium and moderate tenderness over the appendix Bismuth radiograph shows marked stagnation with puddling at the end of nine hours

*Operation* (April 20) —The appendix normal in appearance lying to the outer side of the caput coli, is removed An unusually well-developed ligament of Treves evidently caused angulation and obstruction about two inches from the ileocæcal valve

Discharged June 30, 1914 Constipation was relieved Condition otherwise was about the same

CASE VIII —N B O, aged twenty-nine years and 6 months Admitted March 26, 1914

History Operation for appendicitis in April, 1910 Following this operation felt well until about two months before admission, when right iliac pain and vomiting came on suddenly and very severely This attack lasted about one week About a month before admission had attack similar to the first, lasting four or five days

Well-nourished, fairly-healthy looking man of twenty-nine years Examination shows scar of operation near Poupart's ligament and some tenderness over the appendix region Since one week after the attack of two months ago, patient has been extremely constipated Bismuth radiograph shows nine hours stagnation in terminal ileum

*Operation* (March 4) —A short, thick, and indurated appen-

dix removed A well-developed ileopelvic band divided transversely over the iliac vessels and the rent united longitudinally The band bound the terminal ileum close to the pelvic wall

August 14, 1914 Patient examined on this date Greatly improved since operation, and has gained in weight Bowels move regularly

CASE IX—J H P, aged forty-two years and six months Admitted April 3, 1914

When about twenty-one years of age had very severe attacks of abdominal cramps lasting forty-eight hours or more Five years ago had attack of pain in upper abdomen lasting two months

Four years ago (fall 1910) had a somewhat similar attack, beginning in upper epigastrium and working over toward the right side Continued to have this pain without nausea or vomiting until June, 1911, when gall-bladder was explored and normal condition was found Patient was informed that his appendix had been removed Improvement following this operation until one and one-half years ago when he began to have pain in pit of the stomach, not connected with taking of food, but sometimes relieved by food There has been very marked constipation for the past two years, requiring a purgative twice a week at least During this period he has felt weak, has had more or less constant pain across the back, and has been without "any energy at all" Has lost fourteen pounds in the past two years Chief complaints are, epigastric pain and constipation, constant belching of gas, and loss of energy

Examination shows a fairly well-nourished, sallow man, of forty-two years Over the appendix region there is marked tenderness on deep pressure There is slight tenderness over gall-bladder Radiograph taken nine hours after the bismuth meal shows stagnation and puddling in the terminal coils of the ileum

*Operation* (April 20)—A well-developed ileopelvic band was found attaching the ileum at a point about three inches from the valve to the wall of the fossa over the iliac vessels This band was divided transversely, the peritoneum loosened up from the underlying connective tissue, and the rent untied longitudinally This procedure completely freed the ileum The appendix had been removed at the former operation

This patient was discharged to duty May 27 He had gained five pounds, bowels were moving regularly without purgatives He states that he felt like a "new man" He was examined September 15, five months after the operation He had gained twelve pounds, appeared in robust health, his skin was clear and he had no complaints

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CASE X—G M R, aged twenty-two years and nine months  
Admitted May 11, 1914

History of an operation for acute appendicitis in May, 1913. Fairly good health followed this operation until about six months ago, when he had an attack of pain in the right iliac region with nausea. These symptoms increased in severity so that for the past two or three months there has been continuous pain in the right iliac region, with frequent attacks of vomiting. There has also been rather marked constipation. Bismuth radiograph shows marked nine-hour stasis in terminal ileum.

*Operation* (May 11, 1914)—Extensive adhesions of the cæcum to parietal peritoneum, and of the omentum to both the cæcum and the parietal peritoneum were found. These were carefully separated, all denuded surfaces covered with peritoneum and liberally smeared with vaseline. A portion of the adherent omentum definitely obstructed the ileum near its termination.

This patient made an uncomplicated recovery and was constantly under observation until December 1, 1914. All symptoms were completely relieved by the operation and there was a normal daily bowel movement.

CASE XI—C D F, aged nineteen years. Admitted June 18, 1914.

Had been operated for double hernia, December 16, 1913, history otherwise negative. About six weeks after the operation for hernia, began to have constipation. Bowels would not move for three or four days at a time and not then unless purgatives were taken. About the same time there was first noticed abdominal pain coming on almost daily, and felt to the left of the umbilicus. Felt dizzy, eyes would become blurred, and had one attack of fainting. These symptoms continued until date of admission.

On admission June 22, 1914, fairly well-nourished, healthy looking boy of nineteen years, with a tired look about the eyes. Examination negative, save for slight tenderness over region of the appendix. Bismuth radiograph showed marked nine-hour stasis.

*Operation* (August 24, 1914)—The abdomen was opened and a normal looking appendix removed. A typical Lane's band was divided transversely and the rent sutured at right angle to the line of incision.

August 25. Condition very much the same as before operation. No longer has abdominal pain, but constipation is unrelieved. Discharged as unimproved.

CASE XII—J A H, aged twenty-seven years. Admitted June 19, 1914.

Present trouble began about five years ago with constipation, headache, weakness, and attacks of pain in right iliac region. Constipation has grown steadily worse, bowels would not move for three or four days at a time. Attacks of abdominal pain would occur once every two or three weeks, confined mostly to region of the appendix. Felt listless, had no inclination to work, and had occasional headaches. Lost about twenty pounds in weight.

On admission a sallow, slightly emaciated man, of twenty-seven years. Complains of constipation, headache, and general malaise. Examination shows slight local tenderness over the appendix region. Bismuth radiograph (Fig 3) nine hours after meal shows stasis of the bismuth in the terminal coils of the ileum and puddling.

*Operation* (June 24, 1914) —A typical Lane's kink present. This was corrected by dividing the ileopelvic band and suturing at right angles to the line of incision. A normal appendix removed.

August 28 Discharged. Bowels move once or twice a day without purgatives. Feels like a "new man." Has gained eight or more pounds. The improvement in the general appearance of this patient was remarkable.

CASE XIII—J G T, aged twenty-seven years. Admitted August 1, 1914.

Present trouble began about two years ago with loss of appetite and regurgitation of food which was soon followed by frequent attacks of abdominal pain, at first occurring daily, later there would be no pain for several weeks or a month. Very shortly after the onset of these symptoms the patient noticed that he had become markedly constipated. For the past two years has taken purgatives almost constantly.

The symptoms enumerated, with slight remissions and exacerbations, continued until time of admission.

When admitted, August 1, 1914, he was a rather thin, anæmic, sallow man, complaining of loss of appetite, constipation and pain in the region of the appendix, and that he feels "dopey," and wants to sit down all the time. Is evidently suffering from a rather severe intestinal toxæmia. Weight 119 pounds.

Examination shows well-marked tenderness over the appendix, fairly well localized. Bismuth radiograph shows marked stasis at the end of nine hours with puddling.

August 6 Abdominal exploration. A normal appendix was removed. A well-marked Lane's band was found attached about two inches from the ileocæcal valve and producing marked

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kinking at this point It was divided transversely and united at right angles to the line of division This procedure apparently entirely relieved the obstruction Before the band was divided the contents of the intestine could only with difficulty be pushed past the kink

The patient was discharged September 4, 1914, twenty-nine days after operation He had gained six pounds and his general appearance had entirely changed From a sallow, unhealthy looking individual he had become a ruddy, healthy man His subjective symptoms have entirely disappeared and he states that he feels like a "new man" His bowels are moving once or more daily

The patient was seen five months after operation He had gained nineteen pounds and was in perfect health

CASE XIV—E L T, aged thirty-five years Admitted October 9, 1914

Past history of an attack, about three years ago, of abdominal cramps, vomiting and vertigo Following this attack felt well and enjoyed excellent health until about seven weeks ago, when, following a straining effort, he experienced a severe pain in the region of the appendix Soon after this pain was felt, vomiting occurred and has been repeated since this date practically after every meal There has been a loss of weight of twenty-six pounds during the past five weeks Bismuth radiograph shows marked nine-hour stasis in terminal ileum

October 21, 1914 Abdominal section The terminal ileum found to be tightly bound to the right iliac fossa by two bloodless bands of peritoneum extending from the surface of the fossa in the neighborhood of the anterior iliac spine to the mesenteric border of the ileum Free division of these bands and undermining the adjacent peritoneum completely liberates the ileum The defect in the peritoneum thus produced is corrected by uniting the peritoneum at right angles to the line of the division of the bands A retrocaecal appendix showing no evidence of inflammation removed

October 26, 1914 Uneventful recovery, has not vomited since operation

December 29 Discharged Vomiting has not recurred Has gained ten pounds Bowels move regularly without purgatives

CASE XV—S B B, aged twenty-three years and five months Admitted November 4, 1914

History About six months ago had severe attack of abdominal pain lasting two or three days Was transferred to hospital and remained four months, during which period attacks of abdominal pain and vomiting frequently occurred



After return to duty attacks of abdominal pain continued until date of admission with occasional vomiting. During this period was slightly constipated. During the whole period felt heavy and dull, was in a "doped-up" condition, and had frequent headaches. Lost about fifteen pounds in weight. Examination shows tenderness over the appendix region and at the hepatic flexure.

Nine-hour bismuth radiograph shows stasis and "kink" in terminal ileum, and twelve-hour radiograph (Fig 4) shows obstruction and abnormality at the hepatic flexure.

November 7, 1914. Abdominal section. Marked kinking of ileum corrected by dividing an ileopelvic band transversely and uniting the defect longitudinally. Appendix removed. An extensive Jackson's membrane present at hepatic flexure, several thickened bands of which cause obstruction and deformity in the neighborhood of the flexure. These thickened bands are divided and resulting small raw surfaces smeared with sterile vaseline. It was evident that the bands cause very considerable obstruction. There were no adhesions in the ordinary sense.

December 9, 1914. Uninterrupted recovery, bowels moving regularly, no headache or pain. Complexion has cleared up considerably.

January 5, 1915. Discharged. General condition greatly improved, complexion almost ruddy. Has gained fourteen pounds. Radiograph (Fig 5) shows obstruction at hepatic flexure relieved.

CASE XVI—I N S, aged twenty-six years and three months. Admitted November 4, 1914.

History. Operated for acute appendicitis in June, 1907, and for adhesions in July, 1908. Had no further trouble until June, 1913, when, after lifting, felt severe pain in right iliac region which was followed by constipation and right iliac pain for about three weeks. He then had no further trouble until three months ago when severe pain was felt in right iliac region which has grown steadily worse, and has been accompanied by marked constipation. Bismuth radiograph shows marked nine-hour stasis. Examination shows marked tenderness in the region of McBurney's point.

November 16, 1914. Abdominal section. The following conditions were found. Adhesions of omentum to right iliac fossa, a band of omentum compressing the ileum. Adhesions of the omentum to parietal peritoneum to the outer side of the ascending colon. This adhesion caused marked obstruction of the ascending colon about three inches from the hepatic flexure. Extensive adhesions between caput coli and right iliac fossa.

All adhesions were carefully separated, omentum ligated where necessary, raw surfaces covered with peritoneum and all lines of

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separations of adhesions liberally smeared with vaseline Recovery uneventful

December 20, 1914 Bowels moving regularly, feels better in every way Complexion has cleared markedly

December 31, 1911 Has gained four pounds Patient states that he never felt better in his life

Bismuth radiographs taken December 30 show that his stasis has been practically entirely relieved

CASE XVII—J F aged forty-one years and seven months Admitted November 4, 1914

History of occasional attacks of pain in the region of the appendix, particularly after slight exercise and when constipated Has had several of these attacks in the past four months Constipation has been marked for the past three years, for which he has taken purgative pills almost daily

On admission a fairly well-developed man of forty-one years Examination shows rather marked tenderness just below and to the inner side of McBurney's point Bismuth radiograph shows nine-hour ileal stasis and stasis in the ascending colon

November 16, 1914 Abdominal section A thickened appendix was removed No Lane's kink There was present a well-developed Jackson's membrane causing marked angulation and obstruction at the hepatic flexure This was freely divided transversely in the region of the flexure and the defect thus produced sutured at right angles to line of division The cæcum was large and freely movable It was fastened to the lateral abdominal wall by three Pagenstecher stitches through the external longitudinal band

This patient was discharged to duty January 25 1915 He had gained thirteen and one-half pounds and felt better than he had for ten years His bowels moved daily without purgatives

CASE XVIII—T H B aged twenty-one years and four months Admitted November 9, 1914

Past history The appendix was removed at the Pennsylvania Hospital, Philadelphia, January 3 1912 Was entirely well for six months when pain was noticed in right iliac region and patient noticed that he was becoming constipated Six months later or about one year ago the constipation had become marked When constipation was especially severe there would be marked pain in right iliac region Improvement then occurred until about six months ago when constipation and right iliac pain returned and have been growing steadily worse Has taken purgatives constantly Bowel movement would give immediate relief of pain Lost about thirty pounds in weight

On admission a thin sallow man of twenty-one years with

heavy circles under the eyes A picture of intestinal toxæmia

Examination shows marked tenderness over the appendix region and slight tenderness in epigastrium and over the hepatic flexure Bismuth radiograph shows marked nine-hour delay in terminal ileum and some delay at hepatic flexure

November 23, 1914 Abdominal section revealed a typical Lane's band causing marked angulation This was divided transversely, peritoneum undermined and incision united longitudinally The marked kinking of the ileum was thus completely corrected A membrane stretched from the termination of the ascending colon to the first portion of the transverse colon caused marked angulation of the hepatic flexure This was divided and the raw edges liberally smeared with vaseline The appendix had been removed at first operation and there were practically no post-operative adhesions in the usual sense

December 8, 1914 Uncomplicated recovery, bowels moving daily, complexion decidedly clearer

January 8, 1915 Discharged Very much improved

CASE XIX—J J S, aged thirty years and four months  
Admitted November 27, 1914

History Was operated for chronic appendicitis December, 1913, appendix removed About a month or more after the operation began to have "sick spells" and headache From this time on had frequent slight attacks of epigastric pain, especially when a straining effort was made About a week before admission had a very severe attack of epigastric pain which persisted until he was admitted Has had no constipation

On admission complains of very severe epigastric pain Examination shows rather marked tenderness over the appendix region Bismuth radiograph shows nine-hour stasis in terminal ileum

December 14, 1914 Abdominal section The omentum is adherent to the right iliac fossa compressing the ileum near its termination The caput coli is firmly adherent to the right iliac fossa The omentum was divided, adhesions separated, raw surfaces covered with peritoneum and liberally smeared with vaseline Uneventful recovery, allowed up

January 8, 1915 To duty, greatly improved Patient states that he has not felt so well in the past year

## DIPHThERIAL AND PSEUDODIPHThERIAL PRIMARY CUTANEOUS INFECTION\*

By ARTHUR E. BILLINGS, M.D.

OF PHILADELPHIA, PA.

WE find, after a rather careful review of the literature, that primary cutaneous diphtheria, unassociated with infection of the mucous membrane by the Klebs-Löffler bacillus, is an unusual condition. I also am unable to find any report of case or cases of primary cutaneous diphtheroid infection, or infection due to the pseudodiphtheria bacillus, as proven by animal inoculation. A number of wound and complicated abscess infections of the pseudo-bacillus type have been reported and successfully treated with vaccines by Heath. There is such a close relationship between diphtherial and pseudodiphtherial infections of the mucous membranes, where they have been heretofore compared, that a reference to cutaneous diphtheria must first be made, cutaneous involvement secondary to faucial, nasal, conjunctival, or vaginal diphtheria is seen much more frequently. However, this is not an extremely common condition, as shown by the statistics compiled by Filatow from St. Anne's Hospital, Vienna, from 1894 to 1902, where only 23 cases were seen among 2217 diphtheria patients treated. The infection in this type of cutaneous diphtheria occurring secondarily to mucous membrane infection takes place first by continuity of structure from mucous membrane to skin—as in extension from the nares on to nose and lips, as in vaginal extension to the external genitalia—or, as is occasionally seen in the laryngeal type, with an extension from a tracheotomy wound on to the surface of the neck, and, second, by transplantation of the bacilli to distant parts, the implantation occurring on an abraded surface, a scratch or a blister as in one of the cases reported by Guthrie, who, while suffering from a faucial diphtheria, developed pneumonia, for which he was blistered on the back, and subsequently developed cutaneous diphtheria at the site of the blister. A number of cases illustrating this type have been reported. McCollom states that diphtheritic lesions of stomach and duodenum are occasionally found. Durk, Gunther and Muller have reported intestinal cases, and Schodel has isolated the diphtheria bacillus from the feces, these findings might explain the few cases of perianal diphtheria on record. The perianal region in infancy or early childhood is frequently the site

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\* Read before the Philadelphia Academy of Surgery, April 5, 1915

of excoriations, intertrigo, eczema, etc., which are etiological considerations in the development of such a lesion

I have found reports of 25 cases of primary cutaneous diphtheria without simultaneous or subsequent mucous membrane involvement, and in order to make clear the clinical appearances with which the infection may clothe itself, it is necessary to recall, in a brief way, portions or extracts of the clinical reports of some of these cases

Bolton and Schottmuller report diphtheritic ulcers in groins of two children under two years of age, Bolton's case developed extensive paralysis. Heelis and Jacob make a most interesting report of four cases from the same dormitory of an orphanage, which had been quarantined on account of a case of faucial diphtheria. Two of these patients were suffering from frost-bitten blisters on dorsum of toes, a third from the same condition on her heel, all three developed cutaneous diphtheria at the named locations, the fourth developed a similar lesion on the dorsum of her hand. Hassenstein, Toch, Freymuth, and Petrusky report diphtheritic ulceration of the umbilicus in infants. Fleisch's case was that of an infant, 2½ months old, previously burned, who was kissed by a person suffering from diphtheria of the throat. Patterson's case concerns a young woman with a lesion on her right forefinger, who subsequently developed paralysis of all extremities. Gunther reports a case in a girl, two years old, suffering from an acute phlegmon of the abdominal wall with vesiculation resembling erysipelas. Ehrhardt reports 3 such cases without mucous membrane involvement, and 1 with subsequent throat infection. Sowade's case showed multiple ulcers on the right arm and thorax soon after vaccination, in a child of nine months. Guthrie quotes Rosenthal, as follows, in describing the death of Griesinger: "A perityphlitic abscess had been opened, which subsequently became infected with Klebs-Löffler bacillus after it had healed. He later developed a wide-spread paralysis involving all extremities, speech, deglutition, dying on the seventieth day from respiratory paralysis." Post's case was that of an adult male, who had cared for his brother-in-law, wife and child during their illness from diphtheria. His lesion was on the foreskin, complicated with an acute phimosis, and was 4 weeks old on his entry to the hospital. A dorsal incision, having been made by his physician, was covered with the diphtheritic membrane, from which bacilli resembling morphologically the diphtheria bacillus were obtained, but not until bilateral ciliary and paralysis of all extremities had supervened. McCallom adds that several similar cases have been observed at the South Department of the Boston City Hospital, and that diphtheria of the penis is more frequent than is generally supposed. Kerr, Sack, Gerloczy, Dutschlander and Schucht have observed cases of cutaneous diphtheria unassociated with mucous membrane infection, in addition to these just referred to. There have been reported by Toch, Freymuth, Petrusky and Reichold, Veiel, Sharp and Bertelli, 5 cases of primary cutaneous diphtheria, with secondary mucous membrane infection. In Sharp's case the lesions were multiple over the chest and face, with secondary involvement of the throat, Bertelli's case, confirmed by animal inoculation, was a colleague who had a blister on the upper lip while treating a case of diphtheria of the throat, the blister became the seat of a diphtheritic infection, covered with membrane, and subsequent throat infection, which yielded promptly to antitoxin subcutaneously, without causing improve-

## PRIMARY CUTANEOUS DIPHTHERIA

ment in the cutaneous lesion (to this he applied Bandis bivalent serum, the wound healed in a few days) Slater reports a case of 3 years' duration in a female, with multiple lesions on the body, probably originating in the conjunctiva, with later ear and vaginal involvement. The case had received all sorts of local treatment and had been under antisyphilitic treatment for 2 years. Finally, after careful bacteriological study, the cause was determined, and treatment by the use of antitoxin subcutaneously instituted. At the end of 5 weeks, all lesions had healed and the patient was considered cured.

### CASE REPORTS

CASE I—I wish to add the report of a male, forty-seven years old, school janitor, referred to Dr. Gibbon's service at the Jefferson Hospital by his physician, Dr. Roberts, of Llanerch, Pa. About November 12, he was helping to fumigate, and scrubbing the floor of a school then quarantined, on which a child supposed to be ill with diphtheria had vomited. During this time he suffered an abraded wound of the left middle finger on the dorsum of the second phalanx, a "blood-blister" resulting. Two days later, yellowish-gray streaks appeared about the wound, with pain, swelling and stiffness of the distal joint. On the third day, his physician incised it, applied antiseptic dressing, and later flaxseed poultices, at the end of a week, a membrane or grayish slough had appeared. Similar treatment was continued for some time at the Dispensary of the Jefferson Hospital, without improvement. He was suffering slight constitutional disturbance, vague, shifting pains over body and extremities, with loss of appetite. Two Wassermann reactions had been done and found negative. The wound at this time was covered with a dirty, yellowish-gray slough, fibrous and adherent, extending down to the extensor tendon. The edges were slightly elevated and indurated, presenting an indolent appearance, and covering all of the dorsal surface between the second and third joints (Fig. 1). At this time Dr. Rosenberger was asked to make bacteriological studies, and his report is as follows: "Inoculations were made from the wound upon agar and incubated for 24 hours at 37° C, at the end of this time, an abundant growth developed, which was of a light lemon-yellow color, spreads made and stained with Löffler's methylene blue, and by Groves method, showed bacilli (Gram-positive) possessing the morphology of diphtheria bacilli together with few staphylococci, a guinea-pig was inoculated with 2 c.c. of a 48 hour old bouillon culture, which was absolutely negative as to tonic effects. In bouillon, the growth was manifested by a sediment, in gelatine no liquefaction nor gas production. A vaccine was made from a 24 hour old growth upon agar, and each cubic centimetre of vaccine contained approximately 500 million bacilli, 1 c.c. of the vaccine was given at a time, and four doses were

given at four-day intervals, the patient soon began to improve and the wound healed without further trouble."

CASE II—A girl of seventeen years, with lesion on dorsum of left index finger, almost encircling it, between second and third joints (Fig 2), began six weeks before admission to Pennsylvania Hospital, Out-patient Department (service of Dr Stewart), which was January 19, 1915. The trouble began with a pin-scratch, she was treated at another hospital for four weeks, and by her physician, Dr Hickby, who referred her to the hospital, for two weeks. The wound edges were sharply defined and slightly elevated, showing some redness and induration, the surface of the wound was covered with the characteristic grayish fibrous membrane, and was difficult to remove, which exposed the extensor tendon and matrix of the nail. She had slight constitutional symptoms, with little elevation of temperature that was never recorded above 100°, and the pain seemed less than in the usual acute infection.

Bacteriological examination showed bacilli possessing the morphological characteristics of the Klebs-Löffler bacillus with a few staphylococci. The treatment consisted in the local use of diphtheria antitoxin in the form of a wet dressing on gauze covered with rubber dam to maintain moisture. This dressing was changed every 24 hours for 5 days, when the membrane had disappeared, leaving a clean granulating surface, which healed in about 4 weeks. Unfortunately, the first culture was destroyed before animal inoculation was done, and we were unable to get another after the employment of the antitoxin in spite of repeated efforts.

A summary of the review of these cases of cutaneous diphtheria would seem to show that it is usually secondary to mucous membrane diphtheria, that primary cutaneous diphtheria is an infrequent infection which may manifest itself in a single lesion, or in multiple concomitant lesions distributed over a wide area, or in the form of cutaneous and subcutaneous phlegmon, with considerable induration without marked pain, and without fluctuation or suppuration, if not complicated with pyogenic bacteria, and, finally, it may appear in the form of cellulitis with vesiculation resembling erysipelas. The infection is most apt to take place in wounds offering the most blood serum for the growth of the bacillus, as in blisters. Paralysis, as in other forms of diphtheria, is not an unusual complication, or sequel, and is usually widespread. We also find that pseudodiphtherial cutaneous infection occurs as it does on mucous membranes, and the clinical picture presented is identical with that of cutaneous diphtheria, and cannot be differentiated



FIG 1 —Case I Diphtheritic ulcer of finger

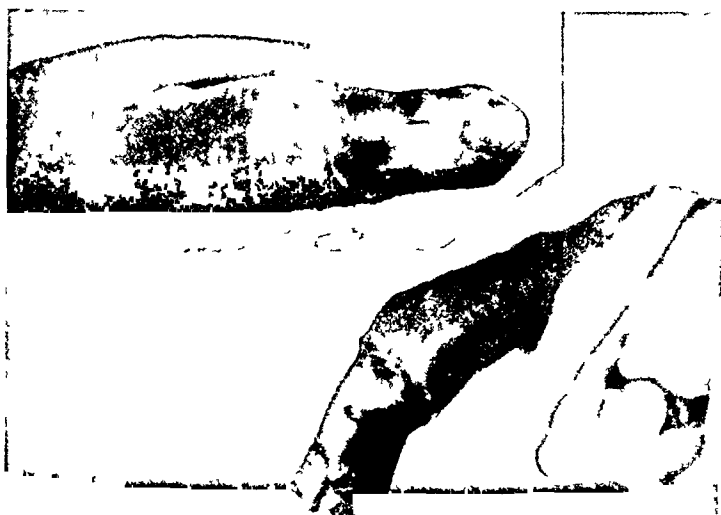


FIG 2 —Diphtheritic ulcers of finger (condition presented in Case II)





## PRIMARY CUTANEOUS DIPHTHERIA

except by animal inoculation. It is obvious that the clinical manifestations resulting from cutaneous infection by the diphtheria bacillus may be as diverse as the changes of environment governing the infection, which only make the appearance of the lesion or lesions more deceptive to the diagnostician. Hence the ease with which it has been mistaken for some of the syphilitic lesions, a tubercular process, a phlegmon, or some widespread skin affection. The treatment of cutaneous diphtheria resolves itself into that of diphtheria of any other part, viz the use of antitoxin subcutaneously or locally, or both, and for pseudodiphtherial skin infections, the use of the autogenous vaccines would seem to be the treatment of choice, and, of course, local surgical cleanliness in both conditions.

I am deeply indebted to Doctors Gibbon and Despard for the privilege of reporting the first case, and to Dr Stewart for the privilege of reporting Case II, and to Dr Rosenberger for his careful bacteriological study and the preparation of the vaccine in Case I.

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# TRANSACTIONS OF THE NEW YORK SURGICAL SOCIETY

*Stated Meeting, held March 24, 1915*

The President, DR FREDERIC KAMMERER, in the Chair

## EXCISION OF SUPERIOR MAXILLA

DR ROBERT T MORRIS showed a young man about twenty-nine years of age, who, 10 years previously, had had the superior maxilla removed for a sarcoma which was growing rapidly. The post-operative deformity was distressing, the eye had a tendency to drop and the cheek to sink. An apparatus was made which has supported the cheek, and, in addition, Dr Douglas injected paraffin and as a result there is now little to indicate that so extensive an operation had been performed. Jaws are used just as normal in eating. Dr Morris pointed out that he made the classical incision but unusually extensive removal of bone.

## PARTIAL RESECTION OF LOWER JAW

DR EDWARD M FOOTE presented three patients showing the effects of partial resection of the lower jaw for epithelioma.

In the first patient the right side of the jaw was disarticulated for epithelioma of the inside of the cheek, not involving the bone. Glands in the neck were also removed, but did not show epithelioma. There was paralysis of the lower lid of the eye, which has since improved.

The operation upon the second patient was performed for recurrent sarcoma in the tissues adjacent to the lower jaw, not involving the bone. A subsequent operation was necessary in the neck for a later recurrence. There was no paralysis of the eye or mouth, and motions of the jaw were good.

The third patient shown had a very extensive epithelioma of the posterior portion of the left side of the lower jaw, involving the inner side of the cheek, the floor of the mouth, the side of the tongue, the soft palate and the anterior pillar of the fauces. After operation this patient for a time was unable to open his mouth owing to the extent of scar tissue, but this gradually softened so that eight months later, at the time of presentation, the incisor teeth could be separated about an inch.

## HEMORRHAGE FOLLOWING GASTRO-ENTEROSTOMY

### CONGENITAL LUES OF STOMACH

DR WILLIAM A DOWNES presented a girl about sixteen years of age, who came under his care when she was fourteen years of age. A diagnosis of congenital lues of stomach was easily established. Wassermann was four plus positive. She was vomiting at that time continuously. After one injection of neosalvarsan, a posterior gastro-enterostomy was done. Then for some time he lost track of her. However, she turned up again and treatment has been resumed. Although not remarkably robust she now feels quite well, eats everything, and her vomiting has ceased.

Dr Downes also presented a boy who, after having been treated at the Rockefeller Institute for five or six weeks with salvarsan, and a diagnosis of appendicitis and lues had been established, was referred to St Luke's Hospital, on account of constant pain in the stomach. An X-ray taken at St Luke's showed a luetic condition of the stomach. Instead of being operated upon he was given a diet, and medication continued. He immediately began to improve. He weighed only 66 pounds and was undersized. He has taken on growth, now weighs 97 pounds and is in every way satisfactory. As the pylorus remained patent and the stomach emptied in the usual time, as shown by X-rays, operative intervention was not necessary.

## HEMORRHAGE FOLLOWING GASTRO-ENTEROSTOMY

DR WILLIAM A DOWNES, in showing a case of gastro-enterostomy, said he did so on account of the rarity of severe hemorrhage following the operation. A man, aged forty-two years, was admitted to St Luke's Hospital, February 18, 1915, with a diagnosis of duodenal ulcer, and was operated upon March 1, a posterior gastro-enterostomy and an appendectomy being done. The anastomosis was made with clamps, and the usual two-row method of suture, the outer being Pagenstecher thread and the inner 00 chromic catgut. The inner suture posteriorly included all coats of the stomach and intestine, and was twice interrupted. The anterior portion of this suture was introduced by the continuous self-inverting method. The needle entered and emerged from the stomach wall at points as close together as possible. It was especially noted that the stomach wall was unusually thick and the possibility of hemorrhage was discussed at the time. For this reason two or three reinforcing mattress stitches were taken and were so placed that visible blood-vessels on the stomach wall were included in the loop. The patient left the operating table with a pulse of 64, regular and of good force. 4 P M, vomited 95 of bright red blood. 5 10 P M, again

vomited, 6 P M, vomited the third time, 12 $\frac{5}{8}$  in amount Pulse had increased to 114, and force had become poor At 7 P M the stomach was washed out with hot water—return was tinged with blood Twenty minutes after lavage patient again vomited a large amount of bright red blood, and at this time was given an injection of horse serum Pulse now reached 130 and patient became restless, and showed the results of severe hemorrhage The vomiting of blood continued in varying amounts at short intervals, and by 8 o'clock it was estimated that the amount measured and lost was fully 32 $\frac{5}{8}$

In view of the rapidly increasing pulse rate, and its poor quality, it was thought best to reopen the abdomen and look for the bleeding vessel or vessels At 9 o'clock, eleven hours after the operation, the abdomen was opened and a four-inch longitudinal incision made through the anterior wall of the stomach, midway between the lesser and greater curvatures The stoma was drawn through this opening by tissue forceps placed at each angle The posterior margin was firm and showed no bleeding, while from the anterior margin there was a continuous ooze No definite bleeding point could be noted A continuous suture of fine chromic gut occasionally interrupted was taken around the entire margin of the stoma, being placed about  $\frac{1}{4}$  inch in depth, and probably including all coats Gastrotomy closed in the usual way Patient's condition was critical and he was given 1200 c c salt solution intravenously Two hours after second operation patient vomited 4 $\frac{5}{8}$  of dark red blood, and for several days the stools were composed almost entirely of old blood

The patient's condition was critical for two or three days, but since then convalescence, barring an intercurrent bronchitis, has been entirely satisfactory, and the wound has now practically healed

#### LATE RESULT OF FOREARM FRACTURE IN CHILD

DR DOWD presented a boy, fourteen years of age, to illustrate the remarkable reparative power which children's bones possess, and to emphasize the difference in the indications for open operation in adults and in children

The boy, who was then thirteen years old, was brought to St Mary's Hospital in December, 1913, with fracture of both bones of forearm Efforts at reduction under ether anæsthesia were twice made, and dressings of board splints and plaster-of-Paris were applied, but, in spite of these efforts, there was a distinct overlap in the bone fragments Fig 1 shows the deformity after these efforts at reduction had been made Previous experience, however, had shown that such cases do

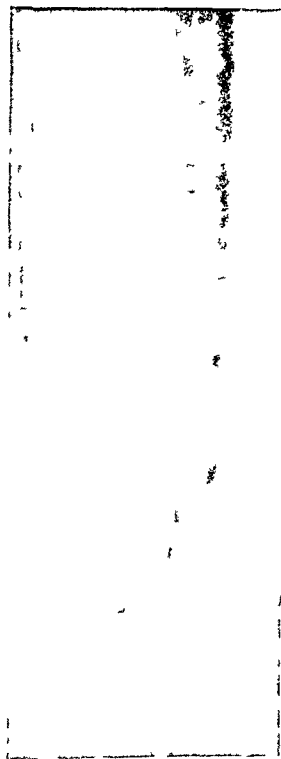


FIG 1 —Fracture of radius and ulna in boy of thirteen. X-ray taken after two efforts at reduction each under ether anæsthesia. Position maintained by dressing of padded board splints and plaster of Paris.

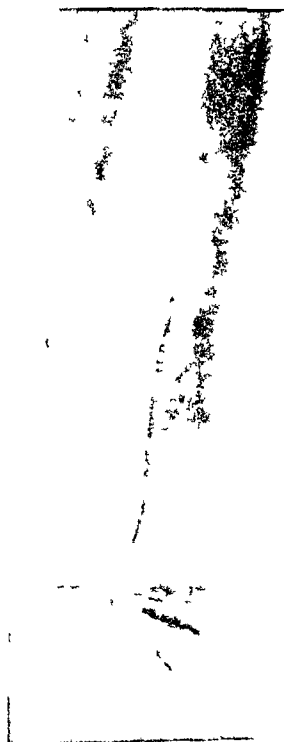


FIG 2 —Same bones as Fig. 1. X-ray taken one year later showing good repair of bones.



## PANCREATIC CALCULI

well, and hence the plaster-of-Paris dressing was left in position and no further procedure was followed. A note was made to find and examine the patient in a year (see Figs 1 and 2). At the end of that period one can hardly find a trace of the injury, the power of motion, the strength and the shape of the forearm are normal. Fig 2 shows the present appearance of the bones.

Children's reparative power after fracture is so great that we should adopt two standards for fracture treatment, one for children and one for adults. It is manifest that an open operation in this child would have been an error. In certain adults, however, open operation is desirable for fractures similar to this one.

## PANCREATIC CALCULI

DR CHAS N DOWD said that in looking over the records of the New York Surgical Society he did not find that a single case with pancreatic calculi has ever been presented to the Society. The patient presented by him was a woman of thirty-two, who has always been well excepting for the symptoms referable to her pancreas. For several years she has had more or less epigastric pain—she began to have very severe symptoms about February 1 of last year, the attacks became very severe, necessitating the use of morphine, they were followed by the passage of small mulberry-like calculi. On the eve of March 19, her husband brought to the reporter several of these calculi and stated that her pain was unendurable and that she had been sent to the hospital for relief. She, similarly, at the hospital begged for operation. She was a strong, well-nourished woman—her temperature was normal, but she looked ill. There was a palpable epigastric mass which included the region of the gall-bladder. On operation the gall-bladder was slightly thickened but otherwise normal. There were, however, spots of fat necrosis on the omentum and there was a large boggy omental mass which extended from the gall-bladder region well over to the spleen. The gall-bladder was drained and the gastrocolic omentum over the head of the pancreas was exposed and protective gauze put about the edge of the exposed area—blunt forceps were then pushed through to the interior of the pancreatic mass and much white pus was liberated. In it there were 30 or more soft, light-colored, mulberry-like stones  $\frac{1}{4}$  inch or less in diameter. A drainage tube was sewed into the opening and packing put about it. Drainage was satisfactory and the wound closed in. It reopened temporarily in the autumn, but has been well since then.



The fluid which was discharged had a slight lipolytic ferment The pus contained staphylococcus pyogenes aureus

The calculi consisted chiefly of cholesterol and cholesterol esters They had practically no ash and cast no X-ray shadows These calculi differed from those which have usually been reported, in that some of them were passed by the rectum Ordinarily, pancreatic calculi lie in the ducts—isolated in the ectasic cavities which they cause—and hence do not escape into the intestine Oser,<sup>1</sup> in 1898, and Kretz,<sup>2</sup> in 1913, gave careful descriptions of them They are very rare, usually small, light-colored, not faceted and are of moderately firm consistency, containing organic material and mercurial salts Bacterial infection is believed to be an element in their production

#### INTUSSUSCEPTION

Dr Dowd presented an infant nine months old, who was brought to the Roosevelt Hospital 20 hours after the beginning of an attack of abdominal pain He had also vomited and had a small bloody stool An indistinct mass could be felt in the left side of the abdomen, and a finger introduced into the rectum encountered the tip of the intussusceptum The five classical symptoms of intussusception were thus present Operation was done without delay and the intussusception was found to have begun at the ileocæcal valve and to have worked downward into the sigmoid flexure It was reduced by pressure and manipulation from below without traction from above The intestinal wall was thickened and œdematous but showed no spot of gangrene This thickening was considered a sufficient safeguard against recurrence and no mesenteric stitches were taken The abdominal incision was closed without drainage and the child made an excellent recovery

A second case was presented which was almost the counterpart of the first The child, however, was three years older, the symptoms had begun 28 hours before admission to the hospital and the intussusceptum could not be reached by the examining finger in the rectum

Dr Dowd said that he brought these two cases of intussusception to emphasize the good result which can confidently be expected if operation is done early and to call attention to an aid in early diagnosis The intussusception almost always occurs in the large intestine Clubbe, in a series of 124 cases, found only one which was entirely in the small intestine In a little child a colonic intussusception can be palpated by bimanual examination with one finger in the rectum unless it is con-

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<sup>1</sup> Oser Die Erkrankungen des Pancreas Nothnagel Specielle Path und Therapie

<sup>2</sup> Kretz Handbuch du Allgemein Path, Krehl and Marchand

## INOPERABLE RECURRENT MALIGNANT TUMOR

cealed beneath the border of the ribs. If it is so concealed the diagnosis can be made by the aid of a bismuth enema and an X-ray picture. On this basis very few intussusceptions should escape an early diagnosis.

### INOPERABLE RECURRENT SARCOMA OF THE UPPER JAW SUCCESSFULLY TREATED WITH MIXED TOXINS OF ERYSIPELAS AND BACILLUS PRODIGIOSUS

DR WILLIAM B COLEY presented a woman, from whom, on June 4, 1914, Dr J H Glass, of Utica, N Y, had removed the left superior maxilla, including the left lower orbital plate, for sarcoma. The diagnosis was confirmed by microscopical examination made by Dr Gifford of Utica. In the latter part of August there was an active recurrence and Dr Glass considered the case as practically hopeless, but advised a trial with the mixed toxins of erysipelas and bacillus prodigiosus, and referred the patient to Dr H H Williams, of Mohawk, N Y, who used the preparation of Coley's toxins. The injections were started on September 1, 1914, the initial dose being  $\frac{1}{8}$  min, they were given daily during the month of September, the first severe reaction occurred after a dose of 2 min, the temperature rising to  $102^{\circ}$ – $103^{\circ}$ . No reaction was obtained after that until  $4\frac{1}{2}$  min were reached. Seven severe reactions in all were obtained during the entire course of treatment, all injections being given systemically. The patient had daily treatments during September, 15 in October, 8 in November, 4 in December, 3 in January, 1 in February, and 1 in March. All evidence of the tumor disappeared in December, and the patient has been in good health up to the present time.

Physical examination at time of presentation (March 24, 1915) shows absence of most of the left superior maxilla over to the malar bone, floor of orbit absent. There is absolutely nothing abnormal either in the interior of the mouth or externally. The left malar bone is normal in size and appearance, her general health is good.

### INOPERABLE RECURRENT MALIGNANT TUMOR OF NASOPHARYNX INVOLVING ETHMOID, SPHENOID, FRONTAL AND SUPERIOR MAXILLÆ BONES (CARCINOMA) DISAPPEARANCE UNDER SIX WEEKS' TREATMENT WITH THE MIXED TOXINS

DR WILLIAM B COLEY presented a man, thirty-eight years of age, who, in August, 1914, first noticed difficulty in breathing through the nose. Shortly afterward he consulted a physician, who found a tumor blocking up both nostrils and extending into the nasopharynx. A portion was removed and sent to Louisville, Ky, for microscopical examination, negative report was received. The tumor grew with great rapidity,

and in the next two months two operations were performed, both incomplete. At the last operation, the tumor was found to extend into the frontal sinuses and involve the ethmoid and sphenoid bones. On December 28 he consulted Dr J M Ray, of Louisville, Ky, one of the leading throat and nose specialists of the South, who gave an absolutely hopeless prognosis, and said that nothing further could be done. Finally, on January 24, 1915, he consulted Dr John B Murphy, of Chicago, who considered the condition entirely inoperable and referred him to Dr Coley for toxin treatment.

The portions of tumor removed at the first and second operations were not kept, and the patient positively refused to permit Dr Coley to remove any further specimens.

He was admitted to the General Memorial Hospital on January 27, 1915. Physical examination at this time showed the patient very weak and anæmic, unable to walk without support. He had severe pain in the head, especially marked in the frontal region, requiring  $\frac{1}{4}$  grain doses of morphine. The whole contour of the forehead and upper portion of face and nose was markedly distorted. There was a tumor involving both nasal cavities, both superior maxillæ, ethmoid and sphenoid bones, producing a pronounced broadening of the nose, particularly marked at the bridge of the nose, which was 2 inches in width, and bulging of the whole frontal region. The right malar bone was much more pronounced than the left, but both were enlarged. There was also marked exophthalmus of the right eye, with dislocation outward for one inch or more, causing inability to focus, he had not been able to read for more than a month. The tumor extended down as far as the upper lip. The patient had a complete congenital cleft palate. The superior maxillæ had been separated by the tumor, causing a space one inch wide in the centre, where one of the incisor teeth had been drawn. Through the cleft in the soft palate a large fungating tumor could be seen, occupying the whole space between the soft palate and the pharynx. This tumor bled very easily, the patient losing more than one-half pint of blood on some days. He had lost twenty-four pounds since August. The disease was so very extensive and the general condition of the patient so bad Dr Coley at first declined to treat him, believing the condition hopeless. He finally consented to try the toxins at the urgent request of his wife.

On January 27, 1915, the toxins were begun, the initial dose being  $\frac{1}{2}$  min, which was injected into the pectoral region. The dose was increased by  $\frac{1}{2}$  min each day. On January 29, there was a slight bleeding from the tumor behind the palate. The hemorrhages increased and, on

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February 3, he lost 5 oz of blood in the morning and 2 oz in the evening. On February 5, there was considerable bleeding which was only partly controlled by spraying with adrenalin and packing. On February 6, 10 c c of horse serum were given subcutaneously, after which the hemorrhages temporarily became much less until, on February 11, he lost 6 oz of blood in the morning and 4 oz later in the day. Another dose of 10 c c of horse serum was administered. On February 12 he lost 12 oz of blood, and on February 13 he lost 5 oz at one time and 2 oz at another. The bleeding continued at intervals of 20–30 minutes during the day. On February 14, there was a slight bleeding from the mouth. By this time the dose of toxins had reached 6 min, causing a slight temperature of 99, but no chill. After the first week, the dose was increased by 1 min per day, and, on February 16, with a dose of 7 min the first chill occurred, which lasted for twenty minutes, followed by a temperature of 101°. From this time on he had no further hemorrhages. The pronounced local and general improvement which had been noticeable at the end of one week's treatment continued. There was marked diminution in the size of the external tumors, as well as decrease in the size of the tumor in the nasopharynx. Eight minims given on February 19 produced no chill, nor did the next three doses of 9½ min each, given on February 20, 21 and 23. On February 24, 9½ min produced a chill. On February 26, 10 min—no chill, on February 28, 10½ min—no chill. On March 1 the same dose as on the preceding day, injected into the pectoral region, was followed by a very severe reaction, the patient had not entirely recovered from the depression of the preceding day. One hour after the injection he had a chill lasting 40 minutes, one hour after this, a second chill occurred, which lasted an hour, the temperature rose to 104° immediately after the first chill. one hour after the second chill it was 104.6°. The patient was in a state of collapse, instead of being cyanotic he became unusually red. The pulse went up to 136 and was very weak, respiration 32. He was not given any stimulants. Two hours after the second chill the temperature fell to 102° and the next morning both pulse and temperature had fallen to normal. The patient was very weak, but was up and about the room.

On March 3, two days later, a very remarkable change had occurred in the tumor as well as the contour of the face, the eyes were much closer together, nearly normal. The exophthalmus, which had become much diminished, had practically disappeared, the bulging in the frontal region had nearly subsided, and for the first time in three months the jaws came together in their normal position. The patient was then given

a respite from treatment for 2-3 days, after which the injections were resumed in smaller doses, 5 min. He received 22 treatments in all while in the hospital. Hæmoglobin, which was 80 per cent when he entered, fell to 68 per cent by the time of his discharge. The improvement continued, he gained in weight at the rate of nearly a pound a day. On the day of his discharge from the hospital, March 9, the following note was made by the resident surgeon, Dr. Dempsey:

Patient discharged March 9. The swelling of the bridge of his nose, between the eyes, has entirely disappeared, the eyes appear to be in a normal position, the cleft in the palate is much narrower, there is now only room for one tooth in the gap of the upper jaw (on entering the hospital this gap was one inch wide), through the opening in the palate only smooth, clean tissue can be seen, there is no evidence of any tumor, the patient's teeth now meet properly, for the first time since months. Except for a little thickness over the nose the subjective symptoms have entirely disappeared. The patient has gained markedly in weight and strength.

For the last two weeks he has been able to breathe through one nostril, and for the last week through both, for the first time since August 15, 1914. He had three X-ray treatments in the early part of February.

Three X-ray plates were taken, the first one, soon after the toxin treatment was begun, showed only a general confused blurring of the whole plate, the outlines of the different bones completely lost.

The second X-ray was taken on February 22, and showed extensive destruction of the bones of the superior maxilla, tubinates, ethmoids, vomer, etc., extending to the sphenoid sinus.

The last X-ray, taken on March 18 by Dr. Holding, showed remarkable changes, the several bones had nearly recovered their normal outline. He has had toxins in small doses, 3-4 min. daily since he left the hospital, and has gained 14 pounds in weight. The contour of his face and nose is entirely normal, and no trace of tumor can be found.

*Later History*—Shortly after the patient was shown before the N. Y. Surgical Society, Dr. Coley succeeded in securing from Dr. Hays in Louisville a slide of the original specimen removed for examination in August, 1914, which had been pronounced negative. This slide was submitted to Dr. James Ewing who reported as follows:

(April 21, 1915) The material received consists of stained sections of two small portions of the nasal mucose invaded by the tumor. The tissue is not sufficiently well fixed or stained to permit of a fully satisfactory study, but it is clear that the tissue is the seat of a malignant tumor process.

The tissue is cedematous and inflamed and infiltrated with groups of tumor



FIG 3 —February 12, 1915



FIG 4 —February 12 1915 side view



FIG 5 —March 18 1915



FIG 6 —March 18 1915

Cancer of nasopharynx disappearing under treatment with the mixed toxins (Coley)

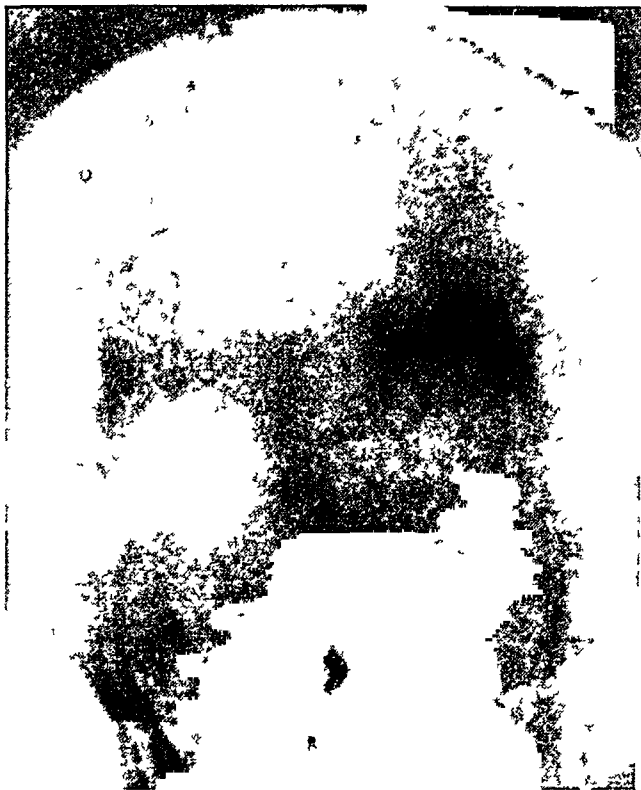


FIG 7 —February 12, 1915



FIG 8 —March 20 1915

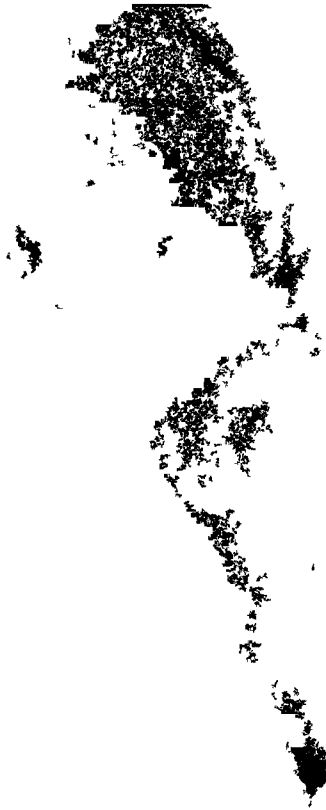


FIG 9 —February 12 1915



FIG 10 —March 20 1915





## INOPERABLE RECURRENT MALIGNANT TUMOR

cells The cells are polyhedral or compressed into various elongated or irregular shapes The nuclei are large homogeneous and hyperchromatic No nucleoli are visible The cells are arranged in large compact groups in which there is no stroma, or in small clusters separated by thin strands of connective The cell groups are widely scattered in the œdematous tissue The overlying epithelium of the mucosa is intact but exfoliating

The exact nature of the tumor it is impossible to state, but the general appearances are those of a carcinoma with poorly differentiated epithelial cells An origin from the lining cells of the mucosa seems probable Of the malignant characters of the process there can be no doubt (Signed) J Ewing

April 15, 1915, Dr Coley received from Dr Ray, of Louisville, the following letter

I have intended for several days to write you and congratulate you on the result in the case of Mr R, who was sent to you by Dr Murphy I saw Mr R the last week in December, he having been brought to me by his local doctor I found the following

He had a congenital cleft palate Apparently springing from the nasopharyngeal space to which it was firmly attached, was a mass that protruded forward filling both nostrils and invading the orbits, separating the superior maxillæ along their median attachment, almost protruding from the nostril in front and bleeding profusely when lightly touched As I have seen a number of cases of so-called recurring fibroma in the nasopharynx and as several attempts had been made to remove this, I considered it a recurring fibrosarcoma starting in the nose and nasopharynx, which growths are more or less familiar to nose and throat men Although I did not have the tissue examined, largely because of the man's physical condition, which appeared to me to be hopeless, it certainly was not an operable case as no form of surgery could have completely eradicated the growth with any hope of success He dropped in to see me while passing through the city on his way home, ten days or more ago I wish to bear witness to the wonderful result (Signed) J M Ray

On March 25, the patient returned to his home in Kentucky and continued to take the toxins in small doses, 2-3 minims twice or three times a week, which failed to produce any reaction At the end of three weeks he wrote Dr Coley that he had noticed a small lump just behind the angle of the jaw on the right side of the neck, he also had a slight return of the headaches, and gradually increasing obstruction in breathing through the nose Dr Coley urged him to return at once, but he was unable to do so until April 26, when he was readmitted to the General Memorial Hospital

Physical examination at that time showed a smooth globular swelling, the size of an English walnut, situated just behind the angle of the jaw, on the right side of the neck and underneath the anterior border of the sternomastoid muscle Tumor freely movable and of

the consistence of a round-celled sarcoma. A slightly smaller mass was present on the left cervical region. The right eye showed a slight return of the exophthalmus, and the upper jaw at the line of the teeth again showed nearly an inch in separation. He had again begun to lose in weight. There was no increase in the width of the bridge of the nose and no return of the fulness in the frontal region, slight return of the tumor in the cleft behind the soft palate. No air could be forced through either nostril.

He was immediately put upon the toxins, beginning with  $4\frac{1}{2}$  minims, and increased by 1-2 minims each day. He proved to be much less susceptible than during the former period of treatment, and did not get any chill until a dose of 25 minims had been reached. He continued to lose in weight, and the headaches remained about the same, until the dose had been increased up to the point of producing a severe reaction, when he again showed very remarkable improvement, the headaches disappeared and he gained two pounds in weight in 3 days. During the third week in June he had two severe chills.

July 1, 1915, his condition is as follows. Appetite has returned, the separation in the jaw is narrowing (it is only  $\frac{3}{8}$  inch now) and the gland underneath the angle of the jaw is not more than one-fourth the size it was on April 26. He is receiving five injections a week and is now taking 27 minims of the toxins.

He had three X-ray treatments during his second stay in the hospital.

August 3, 1915, examination to-day shows no trace of tumor. The exophthalmos has entirely disappeared as well as the enlarged glands on both sides of the neck. The separation in superior maxillæ has reduced to normal and he breathes freely through both nostrils. He has regained most of his lost weight and feels as well as usual. During July the toxins were given three to four times a week, the largest dose being 32 minims. He was discharged from the hospital July 31, 1915.

This case is especially noteworthy and instructive for the following reasons:

1. After a very far advanced and inoperable malignant tumor had apparently disappeared under toxin treatment, a quick recurrence followed a reduction in the size of the dose from ten minims to two or three minims.

2. The recurrent tumors, both primary and metastatic, grew rapidly and showed no signs of control until the dose of toxins had been increased to more than double the amount tolerated during the first period of treatment.

3. Under these large doses and severe reactions all evidence of

## LYMPHANGIOPLASTIC FOR ELEPHANTIASIS

both primary and metastatic tumors again disappeared, and the patient's general health was restored

This case would seem to confirm the opinion previously expressed by Dr Coley, that the success or failure in a given case depends largely upon (1) the proper, but often very difficult adaptation of the dose of toxins to such cases and (2) continuation of the treatment for a long period

*Stated Meeting, held April 14, 1915*

The President, DR FREDERIC KAMMERER, in the Chair

### LYMPHANGIOPLASTIC FOR ELEPHANTIASIS

DR ALEXIS V MOSCHCOWITZ presented a patient fifty-seven years of age, who was admitted to Mount Sinai Hospital January 13, 1915, with the following history Patient had had typhoid fever thirteen years ago, which lasted three months During his convalescence, he noticed a swelling of both legs (presumably phlebitis) After his discharge from the hospital he was able to resume his work, but gradually he became more and more incapacitated Eight years later, he again entered a hospital and was operated upon, the operation consisted of a circular incision in the upper part of the right calf Not only did no improvement follow this operation but, as may have been expected, the operated leg became materially and progressively worse

When admitted to Mount Sinai Hospital the right leg presented a grotesque appearance It was of a uniformly dark brown, mahogany color, covered with crusts and scales The skin was greatly thickened, and was elevated in massive folds After cleansing, innumerable veins were seen coursing throughout its texture A similar condition, only less marked, existed in the left leg As the condition of the skin was such as to preclude the possibility of obtaining an operative sterility, the patient was temporarily transferred to the dermatological service of Dr Goldenberg, where he was treated with various emollient ointments and elevation of the extremities By February 10, the condition of the skin became such that the patient could be safely operated upon It was evident that the patient was suffering from a lymphstasis induced by the original phlebitis and made worse by the circular incision The various procedures possible in this condition were carefully considered, namely, excision of blocks of skin (Kusnezow), the re-establishment of the lymphatic circulation (Handley), the deviation of the lymph from the superficial to the deep lymphatics (Kondoleon-Rosanow) The last mentioned was finally decided upon as being the least risky and the one promising the greatest amount of success

The operation was performed in the following modified form. Four longitudinal incisions were made on the outer and inner aspects of the leg respectively. The skin was dissected back and a large quadrilateral flap was elevated, consisting of either the fascia lata or deep fascia, so that it was free on three sides, and still attached on the fourth side. A deep groove was now made in either an intermuscular septum or through the muscle itself and down to the bone, into which the fascial flap was fastened by catgut sutures. The defect in the fascia was then closed, and over that the skin was united. Primary union followed, except at the intersection of the old circular incision, and the patient was discharged seventeen days later.

Even in the short time that has elapsed since the operation there has been considerable improvement, and in view of this fact it is quite possible that the improvement will continue. The patient will be kept under observation in order to learn the late result of the operation in these otherwise hopeless cases.

#### EXCLUSION OF COLON WITH UNUSUAL COMPLICATIONS

DR MOSCICOWITZ presented a patient, sixty-one years of age, who had been operated upon at the Hai Moriah Hospital in February, 1914, for a carcinoma of the sigmoid flexure. It was his intention at the time to excise the tumor, to close both ends, and reestablish the continuity of the gut by a side-to-side anastomosis. Just when both ends of the gut were securely closed, and he was about to make the anastomosis, the anaesthetist stated that the condition of the patient was such as to indicate haste in discontinuing the operation. It would have been easy to have established an artificial anus, but the patient was averse to such a procedure and besides it was thought there would be no difficulty in persuading him to whatever secondary operations might become indicated. The operation was therefore hurriedly finished in the following manner. An anastomosis was made between the ileum and the lowermost part of the sigmoid flexure, with a Murphy button, as this, however, would have excluded distally practically the entire colon, a safety valve for it was made in the form of an appendicostomy, through a McBurney incision on the right side. The condition at the termination of this operation is illustrated in Fig. 1.

The patient developed a bilateral lobar pneumonia, which rendered the post-operative course exceedingly stormy, but finally he was discharged in excellent condition. No amount of persuasion could induce him to submit to any further operation.

For several months there were no untoward symptoms on the part

## EXCLUSION OF COLON

of the unilaterally excluded colon. In spite of warnings, the patient withdrew the small drainage tube from the appendicostomy wound. This gradually contracted, and then trouble began. The patient complained of cramp-like pains and distention of the abdomen. When the abdomen became distended to a maximum, there were also intestinal erections, and amidst violent pains the patient would suddenly pass a large amount of very foul smelling flatus, followed by a collapse of the abdomen. These were evidently retroperistaltic evacuations of the colon through the ileosigmoidostomy. On an average, there were four liquid stools a day. The patient's condition became progressively worse, and finally he was persuaded to enter Mount Sinai Hospital, where he was admitted October 26, 1914.

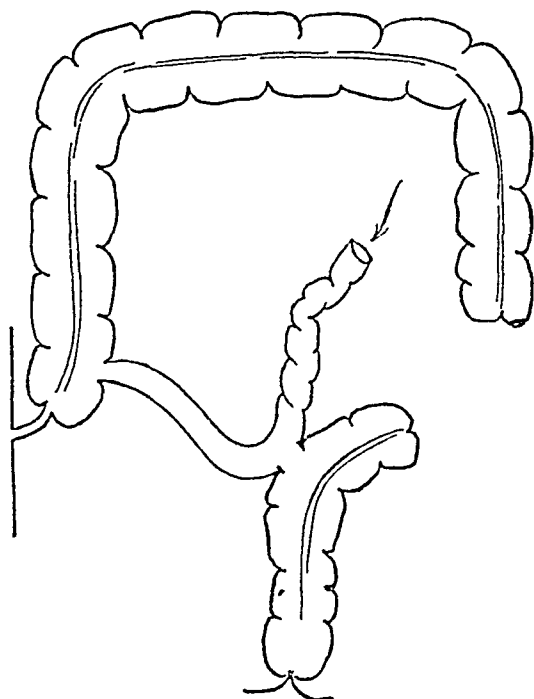


FIG 1 —Diagrammatic presentation of case after first operation, showing the ileosigmoidostomy and appendicostomy

The physical examination revealed a well-healed median abdominal scar, a scar with considerable herniation in the right lower quadrant of the abdomen, in the centre of which there was a tiny fistula which discharged a droplet of mucoid pus, and which could not be probed into the depth. There was some doubt as to the indicated procedure, and finally the following plan was decided upon.

*Operation* (October 28, 1914) —Colostomy in the descending colon through a Kammerer incision. No metastasis was found on exploration. The colon was enormously hypertrophied and dilated, a single

loop of small intestine was adherent to its occluded end. A small area of the colon was sutured into the wound, and was opened three days later, giving vent to a large amount of gas and brownish fluid.

Between October 28 and October 31, the bowels did not move at all. Thereafter, they moved on rare occasions per rectum, but most of the time very freely through the left-sided colostomy. The condition of the patient at this stage is illustrated in Fig. 2.

November 18, 1914, third operation. Entrance through the McBurney scar upon the right side of the abdomen. First, the appendix was extirpated in the usual manner, then the ileocaecal valve was

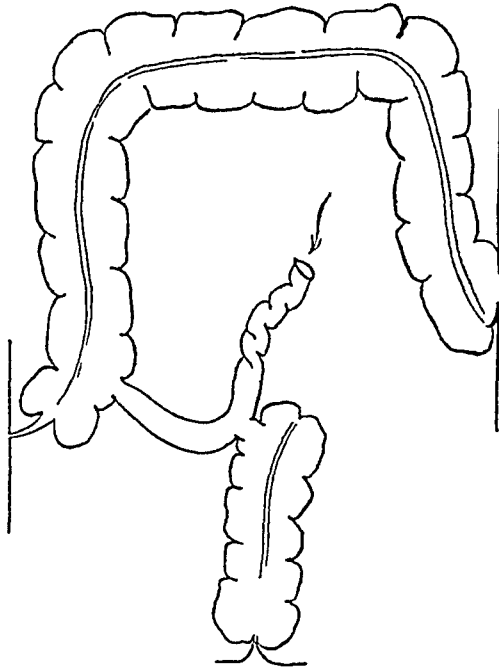


FIG. 2.—Diagrammatic presentation of case after second operation, showing ileosigmoidostomy, appendicostomy, and colostomy in descending colon.

exposed and the ileum traced back to its junction with the sigmoid, about eight inches. The ileum was then divided, both ends closed by suture, and dropped back. The McBurney incision was repaired in layers. The condition of the patient at this stage is illustrated in Fig. 3.

After this operation, the patient was most uncomfortable, being considerably distressed by obstinate hiccough and vomiting. A rectal tube was passed on November 20, and about fourteen ounces of a bloody fluid, mixed with feces, were withdrawn. This showed that at that time the original stoma was apparently still intact. Thereafter, all attempts to move the bowels, by frequent and repeated enemata,

## EXCLUSION OF COLON

and by various cathartics, were ineffectual. In spite of the discomforts, however, the general condition of the patient did not deteriorate rapidly, and it was deemed justifiable to wait further developments.

On November 26, a futile attempt was made to expose the ileosigmoid anastomosis with the sigmoidoscope. On November 30, a second attempt was made by the adjunct surgeon, Dr. Wilensky. "The sigmoidoscope was passed, high up on the side, an opening was seen, an attempt to enter this with the sigmoidoscope was successful, apparently mucosa of a different nature was seen, and then the instrument was withdrawn." Eight hours later, after an ineffectual enema, the patient had four stools, on the following two days there was diarrhœa,

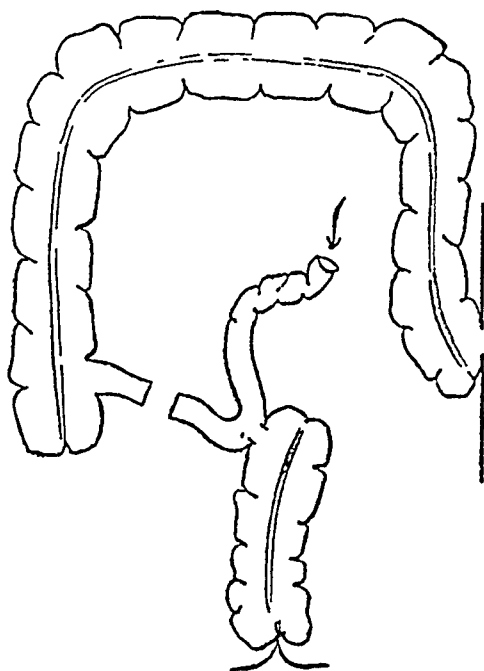


FIG. 3.—Diagrammatic presentation of case after third operation showing ileosigmoidostomy, extirpation of appendix, and occlusion of ileum.

thereafter, one or two movements daily, and the patient was discharged at his request on December 8.

He was readmitted December 15. Following his discharge he was well for four days, then, after an indiscretion in diet, he again became obstinately constipated, accompanied by hiccough, vomiting, and distention of the lower and central part of the abdomen. However, within twelve hours after his admission, a liberal evacuation was obtained with the aid of castor oil and enemata. But again absolute constipation followed. His general condition was so wretched that, though at first Dr. Moschowitz was greatly disinclined to operate, he finally consented to do so when the patient was almost moribund.



a double fold of chromicized pig's bladder was passed around the artery so that it made a loop about the artery wall. The loop was drawn taut so that the pulsation in the sac completely disappeared, but was so regulated that the artery distal to the constricting ligature could be felt to pulsate quite distinctly, although the volume of this pulsation on the proximal side was less than one-fifth that in the artery above the constricting band.

In order that a broad constricting band should be present, a second loop similar to the first was passed about the artery just above the first mentioned ligature and fastened so that it did not interfere with the pulsation above described. The chromicized bladder strip in each case was fastened by one friction knot, and the free ends were then fastened to the subperitoneal tissues by a number of chromicized catgut sutures passed through the pig's bladder and through the fascia. The peritoneum was then closed over the ligature with plain catgut. The abdomen was closed in layers, using silkworm-gut and figure-eight stitches. At the close of the operation there was no pulsation felt in the aneurismal sac.

The patient's convalescence was uninterrupted and pulsation in the aneurismal sac was absent until April 10, when a return of the pulsation was noticed, which has gradually increased to the slightly expansible pulsation which now exists in the tumor mass.

Partial proximal occlusion of the artery in the treatment of aneurism was recommended by Porta in 1850, and subsequently Nazzetti used a fascial flap, Halstead an aluminum band and later a strip of aorta, and Matas and Allen aluminum bands for the purpose of partially occluding the vessel entering the aneurismal sac.

In this particular instance it seemed to the reporter that the chromicized pig's bladder, which can be readily obtained, would fulfil all the indications in the case, and that partial occlusion by means of the pig's bladder could be used as a preliminary step to a subsequent Matas operation, inasmuch as the Matas operation at the first sitting in an actively luetic blood-vessel seemed unlikely to succeed, and because of the possibility of an insufficient collateral circulation to maintain the nutrition of the leg. It is possible that the present pulsation is due to either the establishment of this collateral circulation, or possibly to the return of the full force of the blood stream along the course of the artery due to the absorption of the pig's bladder.

On April 5, 1915, an aspirating needle was passed from the outer aspect of the sac for about four inches into the sac itself. There was a very thick quite tough sac wall, and only semifluid, chocolate-colored

## LYMPHOSARCOMA OF THE JEJUNUM

blood was obtainable, an indication that at that time, that portion of the sac wall which the needle entered had no arterial blood in it

## LYMPHOSARCOMA OF THE JEJUNUM

DR HITZROT presented a man aged thirty-five years, who was admitted to the First Medical (Cornell) Division of the New York Hospital, March 3, 1915, with the history that six months before admission he began to suffer from pain in the epigastrium, which pain has been almost constant since that time. The pain is present before meals, is worse after eating and this increase in pain lasts for several hours. The pain after eating is accompanied by nausea, but he has not vomited. During the last three months, the pain has become more aggravating. He has been persistently constipated. He has no cough. He has had occasional night sweats. One year ago his weight was 150 pounds, now he weighs 118. His physical examination was negative except for the scars of an old burn over his chest and some epigastric tenderness. At different times a mass could be felt to the left of the median line, which was tender and freely movable.

Numerous test meals were made which showed a constant absence of free hydrochloric acid and a total acidity of 10, with a positive guaiac test. There was no gastric retention. The X-ray pictures were negative, except for a certain amount of irregularity about the pyloric antrum without any pyloric obstruction or gastric retention, and nothing abnormal was visible in the small gut. His Wassermann was negative, and the blood and urine showed nothing abnormal.

March 19, 1915, he was transferred to the First Surgical (Cornell) Division at the Hospital, and an exploratory laparotomy was done on March 20 under gas and ether anæsthesia through a four-inch incision in the epigastrium just to the right of the median line. On opening the abdomen peritoneal surfaces were found perfectly normal. The stomach was explored and both by inspection and palpation was entirely normal throughout. The gall-bladder was normal. There were three tumor masses found in the upper portion of the small intestines, occurring in that portion of the jejunum about 20 inches from the ligament of Treitz. There were no other masses at any point in the small intestines.

Resection of the tumor-bearing mass with its mesentery was quite readily effected by catching, distal to the tumor, the intestine between two rubber covered clamps, and dividing the intestine so as to leave a free margin at the lower end. In order to go wide of the tumor at the upper portion, it was necessary to strip back the peritoneum and expose the last portion of the duodenum. This was then done and

the duodenum clamped off, a sufficiently free margin being left for the suture, to be spoken of later. The divided segment of the intestine was then removed, the mesenteric vessels being caught by transfixion stitches as they were exposed, and a large wedge of the mesentery was removed, care being taken to remove with it the glands clear back to its attachment. The divided intestinal ends were then approximated and an end-to-end anastomosis done by the Connell method, using interrupted silk stitches for the first layer. This was further reinforced by another layer of silk stitches, and a continuous chromic catgut stitch over at least two-thirds of the circumference of the intestines. The mesentery was approximated by a few interrupted plain catgut stitches. A small rubber drain was passed to the site of the anastomosis and the peritoneum, which had been reflected, was resutured over the duodenum and over the site of the anastomosis. The wound was closed in layers using catgut, figure-eight silkworm stitches with interrupted horse-hair stitches in the skin. His convalescence was uninterrupted and, on April 4, he was sent to the country much improved, with no pain after eating, as had existed before the operation.

Lymphosarcoma of the intestine is a relatively rare condition. Libman (*Mit aus Grenz d Med u Chir*, vii, 4, 5) collected 42 cases, 15 involving the duodenum, 18 the jejunum and ileum, 14 the ileum, and 3 the entire intestinal tract, and of these, the lymphosarcomata were the most common type.

DR ARPAD G GERSTER reminded the older members of the Surgical Society that he had presented two cases before the Society, one of them many years ago. In that one he had shown a specimen of the intestine of the patient who had had a prolonged hemorrhage. When first seen the man was moribund, and nothing could be done for him. At the autopsy examination a sarcoma was found occupying the lower portion of the duodenum, about as large as a small Spanish olive. This sarcoma was the source of the hemorrhage which had filled the entire small intestine. Preceding the last hemorrhage, the patient had had a number of smaller ones, but no diagnosis had been made for the disease was very insidious.

The second case was presented four or five years ago. The patient had an incarcerated hernia of the right side, which was relieved by a radical operation. When he recovered from that he complained that the pains he had had in his belly from time to time had not been relieved, and that he still suffered from them. Some months later, he came to the office, and examination revealed just such a condition as Dr Hitzrot had described, a tumor which was slipping about in the abdomen.

## GUNSHOT WOUND OF THE ABDOMEN

and could be felt first in one place and then in another, as far distant as the right hypochondrium and the left inguinal region. As the pains were occurring frequently, it was thought that the tumor might be a gall-stone. No diagnosis of sarcoma was made, as the symptoms were those of sudden colic, without constipation or vomiting. The patient was admitted to the hospital, an incision was made in the median line, and a small tumor the size of a hen-egg was found occupying the jejunum, seven or eight inches below the ligament of Treitz. It had caused an intussusception involving 5 or 6 inches of the gut. The intestine was resected and removed, and the patient made a good recovery, and is still alive. The pathological diagnosis was lympho-sarcoma.

## GUNSHOT WOUND OF THE ABDOMEN

DR HITZROT presented an adult male, who was admitted to the First Surgical (Cornell) Division of the New York Hospital, April 1, 1915, with the history that he had been shot in the abdomen one hour before admission by a revolver in the hands of an unknown man. He was in considerable shock. There was a bullet wound about one inch above the navel and three inches from the median line. No point of exit could be found. The abdomen was scaphoid, board-like, with signs of fluid in the left flank. There was bright red blood in the urine.

Under gas and ether anæsthesia an immediate laparotomy was done, and the bullet was found to have penetrated the omentum and transverse mesocolon just above the transverse colon. It had then wounded the outer coat of the jejunum, and about 10 cm from the ligament of Treitz had passed completely through the intestine, leaving two wounds from which the mucosa projected, and through which the intestinal contents were being discharged into the mass of blood in the left gutter. The bullet then passed into the left kidney, completely shattering that organ at the hilum. The kidney was removed and its pedicle ligated. The wounds in the gut were closed with silk sutures. A rubber dam drain was passed into the kidney pouch and the wound rapidly closed. The bullet could be felt in the muscles of the back by a finger passed through the wound between the eleventh and twelfth ribs, but could not be grasped by any forceps then available, and was left. The patient made an uninterrupted recovery.

Dr Hitzrot showed the specimen of the kidney removed and an X-ray plate showing the present position of the bullet between the ribs.

DR GERSTER said that he would like to add a few words based on a recent experience. When the late Dr Bull first sewed up successfully a multiple gunshot wound of the small intestine, it was thought a

the duodenum clamped off, a sufficiently free margin being left for the suture, to be spoken of later. The divided segment of the intestine was then removed, the mesenteric vessels being caught by transfixion stitches as they were exposed, and a large wedge of the mesentery was removed, care being taken to remove with it the glands clear back to its attachment. The divided intestinal ends were then approximated and an end-to-end anastomosis done by the Connell method, using interrupted silk stitches for the first layer. This was further reinforced by another layer of silk stitches, and a continuous chromic catgut stitch over at least two-thirds of the circumference of the intestines. The mesentery was approximated by a few interrupted plain catgut stitches. A small rubber drain was passed to the site of the anastomosis and the peritoneum, which had been reflected, was resutured over the duodenum and over the site of the anastomosis. The wound was closed in layers using catgut, figure-eight silkworm stitches with interrupted horse-hair stitches in the skin. His convalescence was uninterrupted and, on April 4, he was sent to the country much improved, with no pain after eating, as had existed before the operation.

Lymphosarcoma of the intestine is a relatively rare condition. Libman (*Mit aus Grenz d Med u Chir*, vii, 4, 5) collected 42 cases, 15 involving the duodenum, 18 the jejunum and ileum, 14 the ileum, and 3 the entire intestinal tract, and of these, the lymphosarcomata were the most common type.

DR ARPAD G GERSTER reminded the older members of the Surgical Society that he had presented two cases before the Society, one of them many years ago. In that one he had shown a specimen of the intestine of the patient who had had a prolonged hemorrhage. When first seen the man was moribund, and nothing could be done for him. At the autopsy examination a sarcoma was found occupying the lower portion of the duodenum, about as large as a small Spanish olive. This sarcoma was the source of the hemorrhage which had filled the entire small intestine. Preceding the last hemorrhage, the patient had had a number of smaller ones, but no diagnosis had been made for the disease was very insidious.

The second case was presented four or five years ago. The patient had an incarcerated hernia of the right side, which was relieved by a radical operation. When he recovered from that he complained that the pains he had had in his belly from time to time had not been relieved, and that he still suffered from them. Some months later, he came to the office, and examination revealed just such a condition as Dr Hitzrot had described, a tumor which was slipping about in the abdomen.

## GUNSHOT WOUND OF THE ABDOMEN

and could be felt first in one place and then in another, as far distant as the right hypochondrium and the left inguinal region. As the pains were occurring frequently, it was thought that the tumor might be a gall-stone. No diagnosis of sarcoma was made, as the symptoms were those of sudden colic, without constipation or vomiting. The patient was admitted to the hospital, an incision was made in the median line, and a small tumor the size of a hen-egg was found occupying the jejunum, seven or eight inches below the ligament of Treitz. It had caused an intussusception involving 5 or 6 inches of the gut. The intestine was resected and removed, and the patient made a good recovery, and is still alive. The pathological diagnosis was lympho-sarcoma.

## GUNSHOT WOUND OF THE ABDOMEN

DR HITZROT presented an adult male, who was admitted to the First Surgical (Cornell) Division of the New York Hospital, April 1, 1915, with the history that he had been shot in the abdomen one hour before admission by a revolver in the hands of an unknown man. He was in considerable shock. There was a bullet wound about one inch above the navel and three inches from the median line. No point of exit could be found. The abdomen was scaphoid, board-like, with signs of fluid in the left flank. There was bright red blood in the urine.

Under gas and ether anæsthesia an immediate laparotomy was done, and the bullet was found to have penetrated the omentum and transverse mesocolon just above the transverse colon. It had then wounded the outer coat of the jejunum, and about 10 cm from the ligament of Treitz had passed completely through the intestine, leaving two wounds from which the mucosa projected, and through which the intestinal contents were being discharged into the mass of blood in the left gutter. The bullet then passed into the left kidney, completely shattering that organ at the hilum. The kidney was removed and its pedicle ligated. The wounds in the gut were closed with silk sutures. A rubber dam drain was passed into the kidney pouch and the wound rapidly closed. The bullet could be felt in the muscles of the back by a finger passed through the wound between the eleventh and twelfth ribs, but could not be grasped by any forceps then available, and was left. The patient made an uninterrupted recovery.

Dr Hitzrot showed the specimen of the kidney removed and an X-ray plate showing the present position of the bullet between the ribs.

DR GERSTER said that he would like to add a few words based on a recent experience. When the late Dr Bull first sewed up successfully a multiple gunshot wound of the small intestine, it was thought a

wonderful thing that the patient survived. The first man in America who sewed up successfully a gunshot wound of the intestine was Kinloch, of Charleston, S. C., in the Civil War. Since then, this material has increased enormously, and it is known that if it is done before peritonitis has set in, or before extensive loss of blood has taken place, recovery may occur in a large proportion of cases, even though the patient has very extensive and multiple injuries.

There is an enormous difference between this form of traumatism and that from blunt, crushing injuries, to which the intestine is exposed, such as occur in being run over by a truck or automobile. The shock in the latter case is much more pronounced and the patient's life is often compromised, even when surgical repair is skilful and prompt. Very often the patients do not recover from the shock, and die in spite of everything that may be done for them.

#### ADENOCARCINOMA OF THE RECTUM

DR PARKER SYMS presented a man, aged sixty-three years, who when first seen by Doctor Syms, April 27, 1912, had shown symptoms a very short time. A few weeks before the date of examination he had been apparently well. He had not passed blood nor excessive mucus and had no signs of ulceration, in fact, his only symptoms were those of constipation due to the obstruction. He had lost some weight and was not feeling in full vigor.

Examination showed an encircling growth about three inches above the anus. It appeared to involve the whole rectal wall, but the rectum appeared to be movable—not attached to the prostate or bladder.

April 29, 1912, with the patient in the Trendelenburg position, the abdomen was opened on the left side. An examination for metastases was made with negative result. The sigmoid was mobilized, so that eventually fourteen inches of the gut were amputated. This extreme mobilization was made possible by making free incisions through the peritoneum on either side of the mesosigmoid. The dissection through the peritoneum was carried as far as the bifurcation of the iliac vessels and the fat and lymphatics were removed as far as that point. After the gut had been thus mobilized, the continuity of the peritoneum was restored by ample sutures, until finally the floor of the peritoneal cavity was completely closed. After the abdominal wound was sutured and dressed, the patient was placed in the lithotomy position, the anus was closed with a purse-string suture and the lower rectum was removed within the sphincters after the manner of Hochenegg. When this

## ADENOCARCINOMA OF THE RECTUM

lower dissection had been carried up as far as this upper dissection had been carried down, the rectum and the sigmoid were pulled down through the sphincters and a stout ligature was applied well above the growth. The rectum was sutured to its new position, particular pains being taken to make a secure junction at the anal margin. The ligature was left in position until the operation was completed. The rectum was divided with a thermocautery.

The patient made a satisfactory recovery. He has fully regained his health and is to-day apparently perfectly well. A few days after the ligature was removed, there was some superficial sloughing of the mucosa, which extended up within the sphincters, but satisfactory healing took place.

At present the patient has what amounts to functional control. He uses a mild laxative, and continues to use an enema each morning. His control is such that he has no soiling and no trouble whatever. To obviate the tendency to constriction, the size of the anus is maintained by the employment of a soft rubber bougie.

Dr Syms said that in his opinion in these cases complete amputation with establishment of a permanent colostomy, doing the amputation by the combined abdominal and lower routes, is undoubtedly the most radical and safe method of procedure. However, such a procedure as was employed in this case has sufficient advantages to tempt the patient to take the increased risk. Removing the mucosa within the sphincters, bringing the rectal stump down through the channel thus established, is sufficiently satisfactory and it is much safer than any attempt at resection with circular anastomosis.

DR FREDERIC KAMMERER said that if the patient had no control over his sphincter and had to take an enema every day, an inguinal opening would seem to be preferable, as it caused less inconvenience to the patient.

Dr Kammerer said that he himself had abandoned resection of the rectum. He thought it the surgeon's first duty, especially when the carcinoma is near the anal opening, to excise the growth and the tissue immediately around it in as thorough a manner as possible. He felt that this was not always done in the attempt to save the sphincters. In the cases where excision can be made of the entire lower end of the rectum, saving the sphincters, and the intestine pulled down and united to the anal orifice, very good results had been obtained by many surgeons. The speaker had not been very fortunate with this operation, owing to sloughing of the lower end of the bowel. When a resection of the rectum is done in continuity with end-to-end suture of the bowel,



a constriction at the line of suture always develops, moderate in degree perhaps, but always present. It had seemed to him that recurrences occurred at this point rather frequently and he had himself obtained better permanent results by amputating the rectum and sacrificing the sphincter. He agreed with Dr. Syms that the safety of the operation is enhanced by establishing a preliminary inguinal anus.

#### CONSERVATIVE SURGERY IN THE TREATMENT OF MALIGNANT DISEASE OF THE VOCAL CORD

DR. GEORGE D. STEWART read a paper with the above title.

DR. FREDERIC KAMMERER said that he was inclined to think that members of the Society had more frequently practised total laryngectomy than the operation described by Dr. Stewart. He himself had had no experience with the latter. A point of interest was the subject of narcosis. In his last cases of laryngectomy he had employed intravenous ether anæsthesia with very good results. Several times the patient had been on the operating table about an hour and a half to two hours and as much as two quarts of the mixture of ether and saline solution had been infused into the veins, according to the method described by Kuemmel some years ago.

The development of granulation tissue at the upper angle of the tracheotomy incision, when the tube had to remain in the trachea for a longer period, was not an infrequent occurrence, and a very troublesome one occasionally. Among a large number of tracheotomies for diphtheria he had often experienced great trouble in the late removal of the canula, which frequently had to be replaced owing to threatened suffocation, either immediately after removal of the tube or at a later period, even when the wound had healed. These granulations also develop on the posterior wall of the trachea when undue pressure is exerted by a faulty tube.

DR. ARPAD G. GERSTER said that when surgical interference in malignant disease of the larynx was first done, one of the great difficulties that the surgeons had to contend with was that few of the laryngologists who first saw the patients were willing to make a positive and early diagnosis. As a rule it was seldom made before the external glands were involved and the intrinsic cancer had become extrinsic. As soon as the glands are involved, the operation becomes dangerous and difficult. The results are also much worse and more disheartening to the patients. In a number of the early successful cases the patients operated upon committed suicide as a result of depression and disap-

## MALIGNANT DISEASE OF VOCAL CORD

pointment Within the last fifteen years, however, especially since the advance in the diagnosis of syphilis and tuberculosis, the laryngologists have become more prompt in making a diagnosis Strong suspicion of cancer justifies early interference, even where the specimen removed by the intralaryngeal method has not given positive evidence of carcinoma After having excluded tuberculosis and syphilis, what else can we have but a neoplasm? He knew of laryngologists who had made the diagnosis of carcinoma without having secured direct evidence until after the operation Because the diagnosis is now made so much earlier, the operations described by Dr Stewart have become possible, and should be performed more frequently than has been the case in the past

DR C G COAKLEY said that the early diagnosis of epithelioma is not more generally made in laryngological work than in other departments of surgery The laryngologist does not always see these patients very early Only once in a while in his experience had he been able to diagnose a case fairly early Probably most of the cases had existed six months or a year before a positive diagnosis of carcinoma of the larynx was made, and that is not a long time In one instance the patient gave a history dating back a year before he was seen, and he lived three years after the diagnosis was made He died from suffocation without a tracheotomy

Most of these cases are rather slow in their progress in patients after fifty-five years of age On the other hand, one occasionally sees epithelioma in patients thirty-five years of age and upwards, and these run a very rapid course, and unfortunately the operative results are not so good

As suggested by Dr Stewart, age is a very important factor in these cases Most of the carcinomas that we see in the larynx are of the slow-growing type, especially is that true where the carcinoma begins, as it frequently does, on the vocal cords There are two different types the carcinoma which begins on the vocal cords, or those that begin above or below the vocal cords The latter are more rapid in their growth and more fatal than those that begin on the cord itself

One reason why the diagnosis of vocal cord cancer is not made earlier is that the only early symptom is interference with the voice There is no pain and no difficulty in swallowing, simply a progressive hoarseness The voice before and after the operation is practically the same So long as the patients are only hoarse, but can make themselves understood, they let weeks and months pass without attention, and then when they consult a physician it is frequently the family physician who does not look after the throat, but gives a little spray treat-

ment, and it may be some months after that before a diagnosis is established

The diagnosis of cancer can be, and is as readily made by the laryngologist as any other condition. There are few throats that are not sufficiently tolerant to allow an examination, and the laryngologist who finds a mass in the larynx and does not determine what it is, fails to do his duty by the patient. If the patient is hard to examine, the differentiation may be made by the aid of the Wassermann reaction or by sputum examination, etc., thus eliminating syphilis and tuberculosis. One should cocaineize the larynx and take out a specimen and have it examined, and if that is not conclusive a second examination should be made. The laryngologist cannot feel the masses or examine them closely, he can only look at them through the mirror, but if what is seen arouses suspicion, a piece should be removed and examined carefully.

In reference to the matter of swallowing following these operations that is mainly a question of how much tissue is removed and where. If the epithelioma is limited to the cord proper and there is not much oedema in the arytenoid region, there is very little difficulty in swallowing. On the other hand, in the case of the patient who failed to appear to-night, the arytenoid on the right side was completely removed, and he has a marked contracture at the present time. He is wearing a tube, and had a great deal of difficulty in drinking—he had to drink uphill, which aided him in swallowing.

Following all these operations, granulations occur in the larynx which are exceedingly annoying, and until recently have given much trouble to laryngologists, who have to watch the case. The denuded interior of the larynx is very prone to granulations, and the patient realizes a sense of obstruction for two or three months. His sputum is blood-stained and he will be suspicious of a recurrence of the disease. The granulations move up and down with respiration in an annoying manner. The laryngologist also may become suspicious and fear that the surgeon did not remove all of the growth, finally he removes a piece of the granulation and finds that it is only granulation tissue, not a recurrence at all.

Recently it has been found that radium applied externally to the larynx will remove granulations in a week or two by causing a thrombosis of the blood-vessels in a very remarkable manner. It has been a very gratifying discovery, and that is evidently what happened to this patient when he went to Johns Hopkins. On account of the great difficulty he was having with this bloody expectoration, he went to

## MALIGNANT DISEASE OF VOCAL CORD

Baltimore, and there, without making any histological examination, they applied big doses of radium, and in a short time he had as nice and smooth a trachea and larynx as any one could wish

The manner of getting at these growths for diagnosis is perfectly simple. If the patient is intractable and cannot stand a mirror, one can administer chloroform and pass a laryngoscope, or employ suspension laryngoscopy. It is very seldom now that a patient is subjected to a thyrotomy without knowing what he is operated for.

# TRANSACTIONS OF THE PHILADELPHIA ACADEMY OF SURGERY

*Stated Meeting April 5, 1915*

The President, DR JOHN H GIBBON, in the Chair

## GYNÆCOMASTIA

DR NATHANIEL GINSBURG presented a man, nineteen years of age, in whom for six months the left breast has slowly and steadily increased in size without evidence of pain, and at present presents the appearance of a young female breast about puberty or a little later (Fig 1) There is prominence of the nipple and distinct mammary tissue hypertrophy, with an areola of pigmentation about the nipple which is more marked than present on the right side There is no record of antecedent injury, unless his occupation (a shoemaker) has predisposed him to occupational traumatism to this region The breast tumor is a diffuse, somewhat circumscribed, enlargement, corresponding anatomically to the normal young adult breast outlines There is no fixation or retraction of the nipple There is no mammary secretion and no enlargement of the axillary lymph-nodes Dr John Speese (ANNALS OF SURGERY, April, 1912) regards this type of benign tumor in the young male breast as an adenofibroma and I am in agreement with his views, believing this case will histologically conform to that type of tumor I do not believe this case in its inception could have been termed "Adolescent Mastitis" unless this is synonymous with adenofibroma

DR JOHN H GIBBON (Transactions of the Philadelphia Academy of Surgery, April, 1912) reported the case of a young man twenty-one years of age, also a shoemaker, upon whom he had operated, and examination of whose tumor showed it to be an adenofibroma of the breast

This is an unusual and rare breast tumor in the male, and since it is steadily increasing in size, with a view of removing the malignant potentiality present, I have advised and shall perform a plastic resection with preservation of the nipple

Note—Plastic resection of the breast and histological examination showed the breast enlargement to be a case of gynæcomastia

DR PENN G SKILLERN, JR, disagreed with Dr Ginsburg in his diagnosis of neoplasm, and regarded it as a case of unilateral gynæco-



FIG 1 —Hypertrophy of breast in a young adult male



## LOCAL DIPHTHEROID WOUND INFECTION

mastia, or physiological metamorphosis of the male breast into the female type, of which there are now about one hundred and ten cases on record. In support of this view, he related the history of the following case, which was seen by him in the Surgical Out-patient Department of the University Hospital (Case-record 39964), March 4, 1914, and reported, together with a photograph, in *International Clinics*, 1914, 24th series, vol 11, p 238

A white male, aged nineteen years, single, student, stated that for the past two years he has noticed a gradual enlargement of the left breast, and that as the result of conversation with some medical students he feared he was getting a cancer. Examination revealed no neoplasm, but a well-developed left breast, corresponding to that of a sixteen-year-old girl. The right breast, the genitalia, and the sexual instincts were wholly masculine. Chiefly for cosmetic reasons, but also to anticipate the malignant degenerations to which anomalous structures are notoriously liable, a plastic operation was performed a year later.

Gynæcomastia may be bilateral or unilateral, and when one breast alone is involved, it is more often the left. Many cases are associated with anomalies of other portions of the reproductive apparatus, such as hypospadias, absence of pubic hair, etc. At times there is a familial predisposition. It might be expected that such an anomaly would show degenerative changes, such as increase in the amount of fibrous tissue, and atypical architecture of the mammary tissue itself. These changes, however, must be considered as part and parcel of this condition, and, *per se*, do not justify the microscopical diagnosis of neoplasm. A tumor could hardly make a male breast mimic so perfectly a female.

## FRACTURE OF THE SESAMOID BONES OF THE THUMB

DR PENN G SKILLERN, JR, read a paper with the above title, for which see page 297

## LOCAL DIPHTHEROID WOUND INFECTION

DR ARTHUR E BILLINGS (by invitation) read a paper with the above title, for which see page 343

DR J STEWART RODMAN related the history of a little girl operated on three years ago at the Medico-Chirurgical Hospital for appendicitis with abscess. The wound was allowed to remain open for drainage. When drainage had about ceased and when the granulating wound was perfectly healthy, a diphtheria epidemic broke out in the children's ward. Several days after the outbreak of this epidemic a grayish



membrane appeared on the granulations in the wound, which kept reforming in spite of being stripped off when the wound was dressed. Finally it occurred to some one that it would be well to have a bacteriological examination made, and there proved to be a local infection of the wound with diphtheritic infection. The child was removed to the Municipal Hospital, made a complete recovery and was subsequently operated on for ventral hernia.

ARTHROPLASTY OF THE ELBOW, WITH A REPORT OF  
FIVE CASES

DR ASTLEY P C ASHHURST read a paper with the above title, for which see page 302

DR GWILYM G DAVIS said that the results obtained by Dr Ashhurst show that arthroplasty in this joint is more satisfactory than in most others. This accorded with his own experience. It would seem, therefore, that surgeons are justified in carrying out more radical procedures in cases with limitation of motion in the elbow than in joints of the lower extremities in which weight-bearing tends to detract from the good results. The question arises of the necessity of retaining the lateral ligaments. In the majority of his own cases he had not retained these ligaments. Instead of making one large flap he had made two, taking one flap from each side. One of the difficulties of the operation is shown in one of his cases in which there was some trouble with the vitality of the flap. This is a serious difficulty in arthroplasties, especially of the knee. The necessity of using in the arm flaps from other parts of the body, like the fascia lata, is not so urgent as in the knee and hip. While very fair results can be obtained by ordinary resection, this resection without the interposition of flaps necessitates the removal of one to one and a half inches of bone to insure movement. When an arthroplasty is done only sufficient bone to allow interposition of the flaps needs to be removed, and this is less than half the amount necessarily removed in an ordinary resection. The arthroplasty, even without the retention of lateral ligaments, if there is no mishap, is almost certain to give a stable joint.

THE OPERATIVE TREATMENT OF FRACTURES OF THE FEMUR,  
HUMERUS, AND TIBIA

DR GEORGE P MULLER presented lantern slides illustrating his subject

REVIEW OF A SERIES OF FRACTURES

DR WILLIAM J RYAN (by invitation) read a paper with the above title, for which see page 293

## BOOK REVIEWS

MODERN SURGERY By JOHN CHALMERS DA COSTA, M D, LL D  
Philadelphia W B Saunders Company, 1914

This is the seventh edition of this book. It is a volume of some 1500 pages and more than 1000 illustrations. It shows real revision, as notable changes and additions have been made. In a former review in the ANNALS OF SURGERY it was stated that the book had a place in surgical literature, it still has, and it fills the place well. This new revision brings it up to date, as well as is possible in these times of constant change. It is a practical and useful book. It has packed into it as much of the science and art of surgery as can well be put into one volume.

There are some features which might attract unfavorable criticism. The views of others are much quoted in matters concerning which the opinion of Dr. Da Costa would have quite as much weight and would be more appropriate. There is a disposition on the part of some writers to present the opinions of others for the purpose of emphasizing what is trite and commonplace, although neither information nor authority are added above what they themselves might contribute.

There is much proper-name nomenclature. Most of it is quite unjustifiable. "Hilton's method" may mean something to Dr. Da Costa, but not to most of us. The method is a good one, and Hilton undoubtedly was an estimable surgeon, for he said "to plunge in a knife is not courageous, as it is without danger to the surgeon, but may be fatal to the patient," but his method of opening abscesses had been employed by many surgeons before him.

The description of treatment of some surgical conditions seems very meager. This is the case in the chapter on club-foot. But no work like this could be expected to contain full information on every subject.

The excellencies of this book so preponderate over the deficiencies that a reviewer is compelled to yield it praise. It is practical, and a valuable working help for the practitioner of surgery.

JAMES P. WARBASSE

CYSTOSCOPY AND URETHROSCOPY for General Practitioners, by BRANSFORD LEWIS, Professor of Genito-Urinary Surgery, Medical Department of St Louis University, and ERNEST G MARK, Professor of Genito-Urinary and Venereal Diseases in the University Medical College, Kansas City, with a chapter by WILLIAM F BRAASCH, Attending Physician to the Mayo Clinic, Rochester, Minnesota P Blakiston's Son & Co, Philadelphia, 1915

Doctor Lewis' position as Professor of Genito-Urinary Surgery in the Medical Department of St Louis University, coupled with his great clinical experience, is certainly sufficient guarantee of the excellence of any work which may be published under his name. He is not only a teacher but a pioneer in the development of urology. Many and important have been his contributions to this department of surgery and his work has been a source of inspiration to numerous pupils who have gone forth to render a good account of their stewardship. In the present work his collaborators are Ernest G Mark of Kansas City, than whom perhaps no other American has made a more complete study of urethroscopy, and William F Braasch of the Mayo Clinic, who has done so much to perfect uretero-pyelography.

In a brief chapter on the anatomy of the bladder, the authors have adopted the suggestion of Pedersen, that the bladder be divided into four segments or quadrants, which plan is very convenient for purposes of systematic study and recording. It is noteworthy that the word *fundus*, which has been the cause of so much confusion in surgical literature, has been omitted.

Twelve pages are employed in an exceedingly entertaining and accurate historical review of cystoscopy, the development of instruments and technic being traced from the time of Bozzini of Frankfort, who in 1806 presented his "Lichtleiter." The labors of Desormeaux, Bruck, Grunfeld and the immortal Nitze, leading up to the development of an instrument which made cystoscopy practicable, are described in some detail, while certain important modifications made by Newman, Boisseau du Rocher, Brenner, Albarran, Valentine, Tilden Brown, Bierhoff and others receive due consideration. One notes several eminently practical paragraphs in the chapter on cystoscopic technic, for instance, the authors remark "It is thoroughly impracticable to describe in its great variations of shape, elevation and vascularity, a 'normal' or 'typical' trigonum. A recognition of these variations within normal limits must result from thorough training in practical cystoscopy."

Ureteral catheterism by the direct, indirect and the Pawlik-Kelly methods is described in detail and the various functional tests are discussed at length. Full credit is given to Rowntree and Geraghty for their contributions on phenolsulphonephthalein. Of cryoscopy it is remarked that even Rumpel, Kummel's most enthusiastic assistant, suggests that its use should be combined with chromocystoscopy and the phloridzin test in order that accurate deductions may be made. In discussing chromocystoscopy, indigo-carmin is mentioned as being administered by intramuscular injection. This is somewhat at variance with the teaching of most surgeons, the preference being given to the intravenous injection of 10 c.c. of a 3/10 of 1 per cent *solution*.

The chapter on uretero-pyelography is concise and the indications for the procedure are clearly defined. The authors state that in a series of over one thousand cases the method has been employed by them with neither fatality nor permanent injury, but no mention is made of the fact that several deaths resulting from pyelography, in the hands of experts, are on record.

The history, armamentarium and technic of operative cystoscopy occupy thirty-three pages. Intravesical cauterization of tumors according to the technic of Beer, which has done so much to reduce the mortality in this formidable class of cases, is given a prominent place.

The chapters on the development of the urethroscope, technic for its employment and operative urethroscopy are well written and generously illustrated. This portion of the work will be greatly appreciated by those whose privilege it was to work with the late Doctor Valentine, for he was not only among the first to introduce the methods of such men as Oberlander, Kollmann and Wossidlo to the American Profession, but labored for years to popularize them. The authors give to Valentine the credit for having devised with the help of Mr. Preston, an electrician of Rochester, the first low amperage lamp. The assertion that it is inadvisable to urethroscope the posterior urethra unless such a procedure is deemed absolutely essential, is greatly to be commended. They consider air inflation as practically indispensable in operative urethroscopy, but their warning against the danger of emphysema and air embolus is emphatic.

BURTON HARRIS

# CORRESPONDENCE

## POST-OPERATIVE BACKACHE

EDITOR ANNALS OF SURGERY

Recently my attention has been called with considerable frequency to the persistent backache that has followed operations upon patients who have been placed in the Trendelenburg, dorsal or dorso-vaginal position

The condition described by the patient is that the backache has been present from the time of the operation and that remedies have been without avail. The back is tender to pressure. Hyperextension relieves the pain.

Treatment for a slipping sacro-iliac joint, enteroptosis, pronated feet, etc., is without result, and the trouble gradually disappears in the course of time or while the patient is under the osteopathic or some other cult.

Lack of support to the lumbar curve while the patient is on the operating table has been mentioned as a cause of backache, and it is not difficult to appreciate that the observation is seemingly correct, if one will lie flat on his back on an operating table for any length of time, some idea of the trouble produced will be experienced.

The following is what occurs when an operation is performed with the patient in the dorsoperineal position. The subject is placed on the flat operating table and drawn down sufficiently to enable placing the feet in the stirrups, then the buttocks are drawn down between the uprights so that they are almost on a plane with the heels. For a good exposure the buttocks are drawn down even beyond this plane.

When this has been done the thighs are hyperabducted and are flexed in the position of hyperabduction. The strain on the back is great and is exaggerated because of the flattening of the lumbar curve. As above stated, the unsupported lumbar curve with the patient in the dorsal decubitus on the table is a potential cause of back strain.

The strain on the back under these conditions to the sacral and hip ligaments must be at times quite severe, and it has been the experience that this form of trauma is slow to respond to treatment. The damage done to the brain-cells through the nociceptors of Crile, even though the patient is under the anæsthetic, cannot be recognized, and it

is probably here that the greatest harm is done I believe firmly as Crile advocates in this kind of injury and that a "brain scar" is produced.

If the above-described recumbent posture produces a trauma of the brain-cells, what physical local damage must be inflicted on the ligaments and articulations of the back of the patient in a dorsal position with the feet in stirrups and the thighs in flexed hyperabduction and the buttocks drawn down to the end of the table between the uprights

The Trendelenburg position is, in my opinion, also a potential cause of backache

In this position the lumbar curve is exaggerated because the thighs are in the position of slight hyperextension which produces a very severe strain on the ligaments of the back To me it is a matter of surprise that more damage is not inflicted Since this subject has been considered, I have been observing what is done to the unconscious patient on the operating table concerning position, and the trauma inflicted must be at times severe By care a considerable percentage of backache, in my opinion, as a post-operative feature, may be avoided, and the following suggestions are offered

*Prophylaxis* 1 The lumbar curve should be supported by a sand-bag or pillow of the proper size

2 The stirrups and uprights should be discarded and replaced by the old-fashioned Clover crutch which will bring the thighs into flexion without abduction, for all of the vaginal and rectal operations can be performed without any abduction

3 In the Trendelenburg position the lumbar curve should be supported and pillows should be placed under the thighs to avoid hyperextension of the back and thighs

CHARLES G LEVISON

San Francisco, Cal

## RUPTURE OF BICEPS FLEXOR CUBITI

TO THE EDITOR OF THE ANNALS OF SURGERY

While reading the article by Dr Alexander in the ANNALS OF SURGERY for May, 1915, on Rupture of the Biceps Flexor Cubiti, I was reminded of a couple of articles which I wrote upon this subject many years ago These seem to have been omitted from the bibliography which was attached to Dr Alexander's article Permit me to add them now in order to complete his bibliography They are as follows

Rupture of the Tendon of the Long Head of the Biceps (With

illustration showing Dissecting-room Specimen ) *Boston Medical and Surgical Journal*, January 17, 1889, p 61

Rupture of the Tendon of the Long Head of the Biceps Brachii Muscle (With four cases and two illustrations ) *Boston Medical and Surgical Journal*, November 25, 1886, p 496

GEORGE H MONKS

Boston, Mass

## THE UTILITY OF THE FATTY CAPSULE IN THE OPERATION OF NEPHROPEXY

TO THE EDITOR OF THE ANNALS OF SURGERY

It seems to be customary to regard the fatty capsule of the kidney as useless in the operation of fixation of the viscus, so that in most text-books on operative surgery it is advised to strip it off and remove it before the process of fixation. For some time past, however, I have been in the habit of turning it to considerable mechanical advantage. Instead of taking it away, it is stripped downward and packed into the cavity which is always left below the lower pole of the viscus after the latter has been raised and fixed. Thus transposed and secured by a stitch which unites it to the visceral and parietal peritoneum, this collection of fibro-fatty material assists in forming a shelf upon which the kidney can rest and thereby relieve the strain upon those stitches that have been passed through the true capsule to secure the kidney to the abdominal parietes.

Prior to the adoption of this method some iodoform gauze was packed into the vacant space, as illustrated in my book on "Practice and Problem in Abdominal Surgery," where what I have termed the "sling" method is fully described. The replacement of this artificial packing by living organic tissue allows the wound to be completely closed.

A ERNEST MAYLARD

Glasgow, Scotland

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# ANNALS *of* SURGERY

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## TYPHOID PERFORATION \*

A STUDY OF 139 CASES AND 16 SUPPOSED CASES OCCURRING IN THE  
PENNSYLVANIA HOSPITAL

By JOHN H GIBBON, M D  
OF PHILADELPHIA

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ONE who writes, and certainly one who reads, a statistical paper must expect to be asked his reasons for doing so. My first excuse is that the subject of "Acute Surgical Complications of Typhoid Fever" is before the American Surgical Association for discussion, and my second that it might prove of interest to study a large series of cases from one institution. Certainly such a series ought to prove more instructive than a collection of reported cases, because in this series are included all the cases operated upon regardless of the issue, all the cases where the diagnosis was made at autopsy, no operation having been done, and all the cases operated upon for perforation and yet in which no perforation was found, a value which unfortunately does not pertain to a collection of cases from the literature.

I should like to say that the 128 cases subjected to operation during the period covered by this study, 1901 to 1915, were operated upon by the following members of the surgical staff of the hospital: Doctors Richard H. Harte, James P. Hutchinson, Robert G. Le Conte, John H. Gibbon, Francis T. Stewart, Charles F. Mitchell, Francis O. Allen, and Arthur E. Billings. I should also like to acknowledge my obligation to Doctor Billings, who made the synopsis of the case histories, which form the basis of this paper.

The history of the surgical treatment of typhoid perforation has been well written by the fellows of the Association, and their contributions on the subject are too numerous to mention individually, and besides, it is not our object to present a bibliography of typhoid

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\* Read before the American Surgical Association, June 9, 1915



perforation, but simply to study all the cases of one institution and give our conclusions from this study. The late J. Alison Scott, one of the attending physicians of the Pennsylvania Hospital (*University of Pennsylvania Medical Bulletin*, May and June, 1905), presented an analysis of 50 cases of typhoid perforation, which had occurred in the hospital from 1901 to 1904, inclusive.

Prior to the period included in Scott's paper, beginning with 1901, there were three cases which should be mentioned. In 1896, Doctor Le Conte operated upon a case of typhoid peritonitis, under the impression that it was an acute appendicitis, and found no definite perforation, but numerous ulcers threatening perforation and a purulent exudate. The patient subsequently developed a fecal fistula, but recovered. In 1898, Doctor Harte operated upon the first two cases of perforation, the diagnosis having been made before operation, both died. Doctor Harte also performed the first successful operation for typhoid perforation in the Pennsylvania Hospital in 1902.

In the beginning of our work of collecting the histories of the cases, it appeared that the total would far exceed the number used as a basis for this paper, but many were eliminated because perforation was not absolutely proven by operation or autopsy, which has been our guide in order to eliminate doubtful cases. We have, however, collected and will refer later to the cases diagnosed as perforation, subjected to operation, and yet no perforation found.

The following table shows the number of cases of typhoid fever treated, with the number of perforations, the general mortality, etc., in the whole period of fourteen years.

Year	Total number of typhoid cases	Total number of deaths	Perforations	Operations	No operation	Recovery in operation cases
May 1901-1902	509	35	8	7	1	2 or 28.5
May 1902-1903	749	55	15	11	4	4 or 36.3
May 1903-1904	690	63	24	19	5	6 or 31.5
May 1904-1905	462	34	9	8	1	0
May 1905-1906	596	56	15	8	7	0
May 1906-1907	700	64	18	17	1	4 or 23.5
May 1907-1908	524	43	14	10	4	4 or 40
May 1908-1909	324	25	8	7	1	2 or 28.5
May 1909-1910	234	19	4	3	1	0
May 1910-1911	227	21	6	5	1	0
May 1911-1912	156	13	2	2	0	0
May 1912-1913	202	14	2	2	0	0
May 1913-1914	304	21	4	3	1	0
May 1914-1915	214	18	10	10	0	5 or 50
	5891	481	139	112	27	27 or 24.1

## TYPHOID PERFORATION

In this series 112 patients were operated upon with 27 recoveries, or 24.1 per cent, in 27 cases no operation was done and all died. A glance at the table shows that between 1909 and 1914 there were 15 operations and no recoveries, but in the past year there were 10 operations and 5 recoveries. These figures, I take it, go to show how valueless is a small collection of cases when one wants to get an idea of the mortality of an operation. Here we have in the same hospital, at the hands of the same group of surgeons, 15 consecutive operations with the mortality 100 per cent and then 10 operations with a mortality of but 50 per cent. Can there be any explanation of this great difference, either in the condition of the patients at the time of operation or in the technic employed? In the 5 years when no recoveries followed operation in 15 cases, there were treated 1123 cases of typhoid fever with a general mortality of 78 per cent, while in the past year, when one-half of the operations were followed by recovery, there were treated 214 cases of typhoid with a general mortality of 88 per cent.

A careful review of the case histories in these two groups does not show that in the first group the type of disease was any more severe than in the second, nor is there anything else discernible in the patients' conditions which would account for the great difference in the mortality rate. One fact, however, which stands out prominently is that in the first group the average time elapsing between the first symptoms of perforation and operation was 20 hours, while in the second group the average time was 10 hours. Of course it is difficult to estimate in many of the cases the time between perforation and operation, but in making our estimate in the two groups, we have deliberately tried to favor the first. With these facts before us, no one can doubt that the difference between a mortality of 100 per cent and one of 50 per cent is at once explained. Delay after symptoms of perforation develop is fatal, every hour is valuable and one must not wait until he is sure that a perforation has occurred before operating. What we must determine is whether the symptoms are suggestive enough to warrant exploration. It is far better to make the mistake in a few cases of operating when no perforation is present than to delay operation until the diagnosis is certain.

Where there is delay it is due either to the physician, the surgeon, or the patient. One of our late physicians was extremely conservative in these cases and would never allow a surgeon to operate early. All of his cases are included in our series. Occasionally the surgeon himself delays operation and usually because he thinks the abdominal symptoms

are due to a thoracic lesion. In order to avoid delay the most intimate co-operation must exist between medical and surgical staffs. For years it has been a rule at the Pennsylvania Hospital, with the one exception already noted, that when a patient suffering from typhoid fever developed abdominal pain, the surgeon as well as the physician was at once notified. This prompt action has resulted in the saving of many lives. The most common cause of delay is in obtaining the permission for operation from the patient or his relatives. In order to prevent this, it is wise to obtain a conditional consent in every case of typhoid fever.

Rather than offer an analysis of the symptoms, pathology, etc., presented in this series of cases, it has seemed wiser to deal with them generally, and see if any new information can be extracted which will aid us in making an earlier diagnosis or improving our operative results. Before going into the important questions of diagnosis and treatment, it would be well to study the errors in diagnosis. First let us take the cases in which operation was done for a supposed perforation, which was not present. There have been 16 of these cases, Scott reporting 7, and we now present an outline of 9 cases, occurring since 1904. Scott's 7 cases may be summarized as follows:

CASE I—*Typhoid two relapses, suppurative arthritis of knee-joint, supposed perforation. Operation, no perforation found. Death 6 hours later. No autopsy and no cause for symptoms found.*

CASE II—*Typhoid, diagnosis perforative peritonitis. Operation, acute appendicitis (not due to ulceration) found. Death from pneumonia 13 days later.*

CASE III—*Typhoid, diagnosis perforation. Operation, no perforation or other lesion found. Pneumonia and recovery.*

CASE IV—*Typhoid, diagnosis perforation. Operation, no perforation or other lesion found. Recovery. Hemorrhage probable cause of symptoms.*

CASE V—*Typhoid, diagnosis perforation. Operation, no perforation or other lesion found. Recovery. Complicated by consolidation of left base.*

CASE VI—*Typhoid, diagnosis perforation. Operation, no perforation or other lesion found. Death 6 days later. Autopsy showed "active Zener's degeneration of the abdominal muscle" where a hypodermoclysis had been given 9 hours before operation. Operator was not informed of the site of hypodermoclysis and yet this probably caused symptoms suggesting perforation.*

CASE VII—*Typhoid diagnosis perforation. Operation revealed perforated appendix not due to ulcer. Recovery.*

Our additional 9 cases are as follows:

CASE VIII—*Typhoid, diagnosis perforation, no perforation or other lesion found. Recovery.*

Male, white, laborer, aged nineteen years, hospital No. 1292, admitted July 18, 1905, on the eleventh day of the disease.

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Patient had been quite ill, very toxic, moderate delirium during most of his illness. On the twenty-third day he had sudden abdominal pain, a chill, two degrees elevation of temperature, pulse jumped from 104 to 168 and respirations from 28 to 34. When seen an hour later, there was moderate tenderness and rigidity over the right rectus, expression drawn and anxious, was perspiring, pulse very rapid and weak, his legs and thighs were flexed, and it was thought that he had typhoid perforation. Was seen by a surgeon, operation advised and done 3 hours after onset of pain under ether anæsthesia. Intestines were examined carefully for perforation but none found. There was no evidence of peritonitis and nothing else abnormal was revealed. The wound was closed without drainage. After the operation the course of his typhoid seemed uninterrupted and he was profoundly toxic. On the fourth, fifth, and sixth days after operation he had chills, blood examination for malaria negative, no infection of the wound, cause of chills not determined. Sixteenth day after operation his temperature became normal and he was thought to be convalescent, but soon developed a swelling and tenderness over the sternoclavicular joint. After this he made an uneventful recovery but was operated upon for an incisional hernia before his discharge from the hospital.

*CASE IX—Typhoid, diagnosis perforation. Operation, no perforation or other lesion found. Recovery.*

Male, white, stone-cutter, aged twenty-one years, hospital No 1570, admitted August 9, 1905. Patient was ill one week before admission to the hospital, began with a chill, headache, slight diarrhoea, and vomiting. He had a moderately severe infection with a positive Widal and 5300 leucocytes. Six days after admission he complained of slight abdominal pain. At this time his abdomen was perfectly soft, no distention, and free from tenderness. On the tenth day after his admission, at 4 o'clock in the morning, he cried out with sudden pain in the abdomen. Half an hour later he had a chill, the abdomen was quite rigid on both sides, but the liver dulness was not obliterated. There was no distention and on auscultation no peristalsis was heard. Pulse became more rapid and weak and respirations increased. One hour later temperature had risen, his abdomen was softer, there was less rigidity, and he was seen by a surgeon at this time, who thought operation was indicated. It was done under ethyl-chloride-ether anæsthesia, right rectus incision. There was a small amount of moderately fetid smelling turbid fluid which escaped on opening the peritoneum. Numerous thickened ulcers were seen, but careful examination did not reveal any perforation. The abdomen was irrigated with salt solution and drained.

with gauze. Shortly after the operation his pulse jumped to 160, was of very poor quality, and he was given a hypodermoclysis of salt solution under both breasts. After this he did well and made an uneventful recovery.

*CASE X—Typhoid, diagnosis perforation. Operation, no perforation found but retroperitoneal cellulitis. Death.*

Male, white, hat-worker, aged twenty-nine years, hospital No 3356, admitted January 22, 1906. Patient came into the hospital complaining of having been sick for three weeks, headache, loss of appetite, constipation, and general weakness. Illness began with a chill. On admission the abdomen was soft, no tenderness or rigidity, his liver dulness was apparently normal, and his spleen was not palpable. Day after admission complained of much severe abdominal pain after an enema. Pain was cramp-like in character, persisted and became worse with repeated vomiting. His abdomen was generally tender, slightly rigid, tenderness more marked in the left iliac fossa. Abdomen not distended. No mass could be felt. The patient's general condition was good. His pulse rate had not changed. Under ethyl-chloride-ether anaesthesia the abdomen was opened through the right rectus and a general peritonitis found. No perforation could be found after a careful search, but back of the peritoneum, extending along the side of the ascending colon and walls of pelvis, there seemed to be an inflammatory mass with a probable purulent collection. There was some lymph around the appendix and cæcum. This mass seemed to extend toward the perineum and a perineal incision was made and a rubber tube introduced for drainage. Patient stood the operation well but vomited a few hours later, became rapidly worse, and died the next day. Autopsy. Many ulcers were found in the small intestine, the bladder was found to be very small and thick. Back of the peritoneum, dissecting up the colon, and extending up to the kidney, was found a large collection of purulent fluid, the origin of which was not determined. The retroperitoneal tissues were very oedematous.

*CASE XI—Typhoid, diagnosis perforation. Operation, no perforation or other lesion found. Death 12 hours later. No autopsy.*

Male, white, laborer, aged thirty years, hospital No 1194, admitted July 10, 1906, on the fourth day of typhoid, positive Widal, leucocytes 3900, rather severe infection with temperature ranging between 102° and 105°. He did well excepting for toxæmia until the fourteenth day, when after a tub he had a chill, pulse became very rapid and weak, abdominal pain, tenderness and rigidity with distention developed. Was seen by a surgeon, who advised operation for a probable perforation. Under ethyl-

## TYPHOID PERFORATION

chloride-ether anæsthesia the abdomen was opened through a right rectus incision, there was no perforation, and the wound was closed. The patient was returned to the ward without any apparent ill effects from the operation. Twelve hours later he suddenly became very much worse and died. No autopsy.

CASE XII — *Typhoid, diagnosis possible perforation. Operation, no perforation found but enlarged mesenteric glands. Recovery.*

Female, white, cook, aged twenty-nine years, hospital No 1986, admitted September 21, 1906, on the tenth day, of a rather severe typhoid, Widal positive, leucocytes 2050, the abdomen was distended from the time of admission, and temperature ranged from 103° to 104°. Her temperature became normal on the twenty-first day and convalescence was established. Eight days later she complained of soreness of the abdomen on palpation, there was found to be marked tenderness along the right rectus and most marked in the right iliac fossa, but the tenderness extended well up into the right hypochondriac region. No mass was felt, liver dulness was unchanged, and her chest was clear. Temperature went to 100, leucocytes, 4 hours after onset of pain, were 4900 and 8 hours after were 4500. Vaginal examination was negative. Both physician and surgeon thought exploration of the abdomen was advisable, although they did not think perforation had occurred, they could, however, not exclude it. Operation under ethyl-chloride-ether anæsthesia, right rectus incision. Careful exploration did not reveal any perforation but there was much swelling of the mesenteric glands. The abdomen was closed without drainage and the patient made an uneventful recovery.

CASE XIII — *Typhoid, diagnosis perforation. Operation, no perforation found but typhoid ulceration of the appendix. Death from general peritonitis 6 days later.*

Male, white, iron-worker, aged twenty-six years, hospital No 846, admitted June 23, 1907, on the seventh day of his illness. He had had headache and anorexia, and complained of severe muscular pains, especially in his legs and back. Stopped work June 19. He ran a rather typical course of typhoid with a positive Widal, and his leucocytes on three different occasions were between 9000 and 10,000. About the nineteenth or twentieth day of the disease he developed slight abdominal pain, confined to the right lower quadrant, without nausea, and considerable tenderness with rigidity of the right rectus. He was seen by the attending physician and surgeon who thought he might have a typhoid perforation. There had not been any marked change in his pulse or general condition. He was operated upon under ethyl-chloride-ether anæsthesia, right rectus incision. The intestine was care-

fully searched for perforation, which was not found, although many typhoid ulcers were found. The appendix showed decided inflammatory changes, enough it was thought to have accounted for his condition. It was removed and the stump inverted in the usual manner. The abdomen was closed without drainage. He did well for 5 days, when his abdomen became distended, he grew rapidly worse, and died on the sixth day after operation. Autopsy showed general peritonitis without perforation of the intestine but with many typhoid ulcers in the ileum. Examination of the appendix showed rather deep ulceration which seemed to be of typhoidal origin.

CASE XIV—*Typhoid, diagnosis perforation. Operation, no perforation or other lesion found. Recovery.*

Male, white, press-feeder, aged twenty years, hospital No 1515, admitted August 25, 1907, on the twenty-fifth day of a moderate infection with a positive Widal and 7750 leucocytes. His fever was never very high ( $101^{\circ}$  to  $103^{\circ}$ ), but persistent, and he was not very toxic. On the fifty-third day of the disease he suddenly cried out with pain in the lower abdomen, more marked in the right iliac fossa. Pain increased on deep inspiration. On palpation there was rigidity of the right rectus and moderate tenderness. Pulse, respirations, and temperature were unchanged. His leucocytes were 9050 shortly after the onset of pain. Two hours later he was operated upon under ethyl-chloride-ether anæsthesia, right rectus incision. There was no peritonitis or free fluid. Intestines were examined carefully for perforation but none found. There were apparently many deep typhoid ulcers in the ileum. The abdomen was closed. The patient's temperature continued slightly elevated for two weeks after the operation, after which it became normal and he was discharged 27 days after operation, cured.

CASE XV—*Typhoid, diagnosis perforation. Operation, no perforation or other lesion found. Recovery.*

Female, white, seamstress, aged fifteen years, hospital No 1640, admitted August 31, 1908, on the sixteenth day of a severe infection with a positive Widal and 6000 leucocytes. On the twenty-second day her temperature dropped to normal and her pulse to 88. Soon after this she had a chill, her temperature rose to  $104.3^{\circ}$ , her pulse in 3 hours jumped to 164 (?), and her respirations from 24 to 44. She had abdominal tenderness and rigidity, she was very much shocked, was given stimulation, and two hours later her condition was very much better. Leucocytes were 4300. Operation advised and done under ether anæsthesia, median incision, the large and small intestines being carefully

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explored but no perforation found The gall-bladder, appendix, and spleen were also explored but nothing abnormal found The mesenteric glands were enlarged but there was very little ulceration of the intestines The wound was closed and the patient reacted promptly from the operation Her fever continued 34 days after operation, but was very slight ( $100^{\circ}$  to  $101^{\circ}$ ) After this she made an uneventful recovery and was discharged cured

CASE XVI—*Typhoid, diagnosis probable appendicitis Operation, thickened and ulcerated ileum found, pre-perforative stage Recovery*

Male, aged twenty years, hospital No 2392, admitted October 28, 1910, with a typical attack of typhoid fever, probably at the end of the first week of his disease On about the fourteenth day he complained of a great deal of pain in his abdomen and a small tender mass could be felt in the region of the appendix With this he had a slight elevation of temperature, but no increase in leucocytes There was little or no rigidity, but considerable tenderness in the region of the appendix The existence of a mass at this time was doubtful Twenty-four hours later a mass, which seemed movable, could be distinctly felt in the right iliac fossa He still complained of pain, there was no rigidity, and there was little change in his general condition from the day before Attending surgeon was sure that he had not a perforation, but felt that he probably had an appendicitis and advised operation The abdomen was opened through a small Kammerer incision under morphia-ethyl-chloride anæsthesia The mass which was felt was the last two inches of the ileum, which was the seat of numerous ulcers, and was enormously thickened One of these ulcers was very thin and was in the pre-perforative stage This was covered by the passage of a purse-string suture The appendix was normal The abdomen was closed without drainage and he recovered

The most striking feature of these 16 cases is that in but 2 did death follow an exploration in typhoid fever, where no cause for the symptoms could be found at operation Five such operations were followed by recovery In 2 of these cases it is probable that the symptoms which seemed to indicate operation were due to pneumonia In 3 of the 16 cases acute appendicitis was found, 1 patient died from pneumonia, 1 from peritonitis, and 1 recovered In another case, hemorrhage probably produced the symptoms suggesting perforation This case also recovered A suggestive case in this group is the one in which pain, tenderness, and rigidity were due to salt solution introduced into the abdominal wall Another interesting case is the one in which a diag-



nosis of acute appendicitis was made and in which a pre-perforative stage of ulceration was found

I think that a review of these cases goes to show that but few unnecessary operations have been performed and that in these few the mortality is surprisingly low. Out of 16 cases, 10 recovered and 6 died, but in the latter were but 2 cases in which no lesion justifying operation was found. In this connection it may be well to say that in many of the cases where perforation was found, the indications for operation were less definite than in these cases and that we are dealing with a condition which, if we wait until the signs of perforation are absolutely positive, we will save but few patients.

Next let us examine the cases in which no operation was done but the perforation found at autopsy. A synopsis of their histories is given later. There are of these 27 cases presenting some interesting features. In the first place, but one patient died, refusing operation, although delay in obtaining consent was frequent throughout the whole series. In 7 cases perforation was suspected but no operation was done, because the patient's condition was considered to indicate a rapidly approaching death and the uselessness of operation. Lung conditions, varying from a bronchitis to tuberculosis with gangrene of the lung, constitute the cause of error in a large number of the cases. In reviewing all the cases it is quite remarkable how seldom operation was done for perforation when a lung condition was responsible for the symptoms and how frequently a lung condition caused us to attribute the abdominal symptoms to it when perforation was also present.

Hemorrhage was frequent in many of the undiagnosed cases and undoubtedly contributed to the error. In but 3 instances is the failure to recognize a perforation attributed to delirium and profound toxæmia.

I should say that the two practical lessons to be derived from a study of these 27 cases is that we must not forget that a pneumonia and a perforation frequently coexist and that the same is true of hemorrhage and perforation.

#### CASES OF PERFORATION OPERATED UPON OR FOUND AT AUTOPSY

The notes of the first 50 cases will not be recorded here as they have already been reported in Scott's paper.

#### CASE LI—*Perforation Operation, and death 6 days after operation*

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Male, white, aged seven years, hospital No 1694, admitted August 22, 1904, on the fourteenth day of a moderately severe infection, with a positive Widal, 8,000 leucocytes, temperature ranging about  $103^{\circ}$ , no complications, and no pronounced toxæmia. On the thirtieth day of his illness he developed sudden severe pain in the epigastrium and right iliac fossa with a rapid weak pulse (last record before attack 120, jumped to 150<sup>?</sup>), costal breathing, respirations increased from 26 to 32, and signs of collapse. Four hours after much abdominal tenderness, pronounced general rigidity, more marked over right rectus, with vomiting and several small bowel movements, and with increasing picture of peritonitis. Operation four hours after onset of pain, ethyl-chloride-ether anæsthesia, right rectus incision. One perforation found, pin-head in size, in ileum a few inches above ileocæcal valve which was sutured and gauze drainage instituted. Death six days later, which was ascribed to inanition, as he did not show signs of peritonitis. Culture from abdominal fluid at time of operation sterile at the end of 48 hours.

### CASE LII—*Perforation Operation Death Autopsy*

Female, white, housework, aged twenty years, hospital No 1983, admitted September 17, 1904, on the fourteenth day of a severe infection with a negative Widal and 6400 leucocytes. Toxic from the time of admission. Complained of pain, but not severe, on the twentieth day, with tenderness, but without rigidity and without any marked change in general condition, except a slightly accelerated pulse. On the twenty-first day had sudden severe pain, after sitting up in bed, referred to right iliac fossa, with shock and collapse, pulse almost imperceptible (140 to 160<sup>?</sup>), respirations increased from 40 to 56, and temperature rose 3.2 degrees, cyanotic, with great tenderness and generalized rigidity of whole abdomen, with more tenderness on right than on left side. Liver dulness obliterated. Operation, ethyl-chloride-ether anæsthesia six hours after onset of pain. Perforation found about the size of a goose-quill several inches above the ileocæcal valve with plastic peritonitis and much soiling of the peritoneum. Perforation sutured, gauze drainage, death 8 hours later, never fully reacted. Autopsy revealed second perforation near cæcum, size not stated.

### CASE LIII—*Perforation Operation Secondary perforation and operation Death Autopsy*

Male, white, paperhanger, aged eighteen years, hospital No 2117, admitted September 28, 1904, on the seventh day of a severe infection, with a positive Widal and 9200 leucocytes. Had distention with slight persistent pain from time of admission. On

the eleventh day this gradually became more severe with slight paroxysms referred to the right iliac fossa without marked change in general condition, except slightly increased pulse rate, moderate tenderness and rigidity of rectus, right more pronounced. Six hours later he had a sudden severe outburst of pain, marked tenderness all over the abdomen with great rigidity and signs of collapse. Operation (soon after), ether anæsthesia, perforation sutured, gauze drainage after flushing abdominal cavity with salt solution. There had been no marked change in pulse, temperature or respirations. Reacted pretty well. Did well for 5 days when he had a chill without much pain but with increased rigidity and failure in general condition. Under ethyl-chloride anæsthesia the former drains were removed, intestines examined, and small perforation found near original (a little nearer the cæcum). This was sutured and gauze drainage instituted again. Death occurred the third day after the second operation. Autopsy. Localized peritonitis, fecal fistula at site of second operation without any other perforation. Death in history ascribed to toxæmia, as peritonitis was plastic and confined to coils immediately about perforation.

CASE LIV—*Perforation Operation Death*

Female, white, seamstress, aged sixteen years, hospital No 393, admitted December 31, 1904, on the eighth day of a moderately severe infection, with a positive Widal and 4850 leucocytes. Abdomen slightly distended from time of admission, but patient never complained of pain or tenderness until the sudden onset of severe generalized pain followed by chill on the nineteenth day. The pulse became weak and rapid, 108 to 140, respirations increased from 24 to 40, with 3.3° elevation of temperature. Two hours after onset of pain leucocyte count 7500 and 5 hours later 10,850. The abdominal respiratory movements were limited to the upper part of the abdomen. Patient restless, with an anxious expression. There was marked tenderness over both lower quadrants (right more marked) with rigidity of both recti. Liver dulness at this time unimpaired. Seven hours later abdomen more tender, rigidity more marked, expression pinched, pulse running and poor, liver dulness almost obliterated, tympany over anterior axillary line to fourth rib. Operation, right rectus incision, pin-head perforation about 4 inches above the ileocæcal valve, sutured, free fecal matter in cavity, irrigated with salt solution, gauze drainage. Death 30 hours later, autopsy refused.

CASE LV—*Perforation Operation Death Autopsy*

Male, white, laborer, aged thirty years, hospital No 3512, admitted February 4, 1905, on the fourteenth day of a mild infec-

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tion, with a negative Widal and 3600 leucocytes. He seemed to be convalescent on twentieth to twenty-fourth day, when his temperature again went up, ranging about  $103^{\circ}$  (higher than before), pulse 108 to 140, respirations 24 to 32 until the thirty-fifth day when he complained of pain, not severe, which gradually got worse. On examination tenderness and rigidity were found and liver dulness was obliterated, except in posterior axillary line. At onset of pain there was an immediate  $3^{\circ}$  drop in temperature with a  $3\frac{1}{2}^{\circ}$  subsequent elevation. Pulse rapid and of poor quality. Operation 3 hours later, local anæsthesia, perforation  $1\frac{1}{2}$  cm in size, 43 cm above the ileocæcal valve, perforation closed, gauze drainage, general peritonitis. Death 15 hours later. Autopsy, diffuse purulent peritonitis, marked congestion of lungs, cloudy swelling of heart, liver and kidneys. Marked ulceration of ileum, cæcum, and colon. No other perforation.

### CASE LVI—*Perforation Operation Death*

Male, white, metal-worker, aged thirty years, hospital No 4206, admitted March 28, 1905, on the fourth day of disease, with a positive Widal and 8400 leucocytes. Seemed to have a rather severe infection, temperature ranging from  $103^{\circ}$  to  $104^{\circ}$ , requiring persistent sponging, but was uncomplicated to the eighteenth day, when he complained of lower abdominal pain (not severe) which persisted all night. Slight tenderness and rigidity over both lower quadrants (right more marked). Twelve hours later pain became very severe, marked generalized rigidity, costal breathing, pronounced tenderness all over the abdomen but more marked in the right lower quadrant, no marked change in pulse and respirations, but temperature dropped from  $100\frac{1}{2}^{\circ}$  to  $96\frac{1}{2}^{\circ}$ , with a subsequent rise to  $101\frac{1}{2}^{\circ}$ , peristalsis almost absent, abdominal breath sounds and liver dulness almost obliterated. Operation, ethyl-chloride-ether anæsthesia, median incision, peritonitis, much soiling and leakage into the peritoneal cavity. Perforation 3 mm in diameter was found in the ileum 25 cm above the ileocæcal valve, sutured, abdomen flushed, gauze drainage. Death a few hours later without reaction. No autopsy.

### CASE LVII—*Perforation Operation Death Autopsy*

Male, white, laborer, aged thirty-five years, hospital No 635, admitted May 23, 1905, on the twentieth (?) day of disease. No record of Widal or leucocyte count. Patient was admitted with a temperature of  $103^{\circ}$  and definite symptoms of peritonitis with a history of fever for 18 or 20 days, which seemed to be enteric. "Has had abdominal pain most of this time which has been severe during the last 10 hours." Operation, ethyl-chloride anæsthesia, right rectus incision. General peritonitis much free purulent

fluid, perforation size of a pea in ascending colon 10 inches above the ileocæcal valve, closed with silk, gauze drainage Reaction poor, death 24 hours later Autopsy Acute purulent peritonitis, cloudy swelling of heart, liver, and kidneys Acute bronchopneumonia Extensive ulceration of ileum and ulceration of colon No other perforation

CASE LVIII—*Perforation Operation Death Autopsy*

Male, white, hospital No 789, admitted June 6, 1905, on the sixth (?) day of a mild infection, with a negative Widal and 6500 leucocytes, which later increased to 13,000 Patient says that he has only been sick 6 days with headache, fever, and abdominal pain Temperature on admission was 102°, after this it was never above 100.2°, showing a subsiding tendency, and was practically normal on the eighth day, when he suddenly developed severe abdominal pain, legs flexed, generalized tenderness and rigidity, which was marked over right lower quadrant, and costal breathing Heart and lungs negative Peristalsis everywhere audible Operative permission refused until 7 hours later Operation, ethyl-chloride-ether anæsthesia, median incision, perforation found 6 inches above the ileocæcal valve and closed Another pre-perforative ulcer was invaginated Reacted well and did well for 2 days, when the tenderness and rigidity increased and he died 30 hours later Autopsy Peritonitis, with another perforation beside the original

CASE LIX—*Perforation Death Autopsy*

Male, white, machinist, aged twenty-six years, hospital No 1068, admitted June 30, 1905, on the seventh day of a severe infection with a positive Widal and 11,050 leucocytes Patient was very sick from time of admission, profound toxæmia, and hyperpyrexia Temperature 103° to 105° On the twelfth day after a tub his pulse became very rapid with circulatory failure and marked cyanosis, pulse increased from 128 to 156 (?) Previous to this had delirium and marked subsultus and profound toxæmia with stupor for 3 or 4 days Death 12 hours later, evidently perforation was not suspected Autopsy Recent diffuse peritonitis, marked ulceration of the ileum, perforation, 1 mm in diameter just above the cæcum, cloudy swelling of heart, liver, and kidneys Congestion of the lungs

CASE LX—*Perforation Death Autopsy*

Male, white, weaver, aged twenty-seven years, hospital No 1329, admitted July 20, 1905, on the fourth day of relapse, with a positive Widal and 4900 leucocytes Had been sick with typhoid for 4 weeks, after which his temperature was normal for several days before his admission to the hospital Seemed very sick on

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admission, developed coma vigil and became very toxic. On the sixth day became worse, small hemorrhage with profuse hemorrhage on the seventh day, for which intravenous salt infusion was done. Pulse rapid and weak, considerable abdominal distention, did not complain of pain or tenderness but slight rigidity on the eighth day. Death on tenth day. No note of suspicion of perforation. Autopsy. Marked ulceration of ileum with ulceration of colon and rectum. General peritonitis. Perforation of ileum. Bronchopneumonia. Cloudy swelling of kidney and liver. Dilatation of right heart.

### CASE LXI—*Perforation Operation Death Autopsy*

Female, white, aged six years, hospital No 1470, admitted August 1, 1905, on the seventh day of disease, with a very suggestive Widal and 14,900 leucocytes. Patient and her father were admitted together, with typhoid. Ran a rather severe uncomplicated course until about the fourteenth day, when she was seized with severe pain (crying out) in the abdomen, expression anxious, with lower abdominal rigidity (more marked over right lower quadrant) and tenderness. No marked change in general condition, perforation diagnosed, permission for operation refused. She steadily grew worse with increasing signs of peritonitis. Operation 24 hours later, chloride of ethyl ether anæsthesia, general peritonitis, perforation found 2 mm in diameter, 11 cm above the ileocæcal valve and sutured, another pre-perforative ulcer invaginated, salt irrigation, gauze drainage, death a few hours later. Autopsy through wound, general peritonitis, but no other perforation.

### CASE LXII—*Perforation Death Autopsy*

Male, white, laborer, aged twenty-nine years, hospital No 1890, admitted September 7, 1905, on the seventh day of a severe infection, with a positive Widal and 8400 leucocytes. Patient became very sick after the twelfth day, marked toxæmia and three hemorrhages on seventeenth and eighteenth days. Marked circulatory failure with delirium. Died on the twentieth day. Perforation was probably not suspected. Autopsy. General peritonitis, typhoid ulceration of bowel with a very small perforation of the ileum, 30 cm above the ileocæcal valve, and another, pin-head in size, 50 cm above the ileocæcal valve, acute splenic tumor, cloudy swelling of heart, liver, and kidneys, congestion of the lungs, fibrous pleurisy.

### CASE LXIII—*Perforation Death Autopsy*

Male, white, laborer, aged twenty-seven years, hospital No 1980, admitted September 17, 1905, on the fourteenth day of a

moderate infection, with a positive Widal and 4300 leucocytes. A suspicion of tuberculosis in both apices (repeated examinations of sputum for tubercle bacilli made with a negative result), and a few days after admission developed a diffuse bronchitis with repeated hæmoptysis for several days, without evidence of pneumonic consolidation. Temperature became lower and was practically normal on twenty-first to twenty-third days. Slight fever again, 100 to 101°, and was again normal on the twenty-ninth day. Slight abdominal pain with elevation of temperature on thirty-third day, became rapidly worse with abdominal tenderness, distention, and rigidity, and died a few hours later. His pulse increased from 80 to 120 within a period of 5 hours. No change in respirations. No note indicating that perforation or operation was considered. Autopsy. Acute purulent peritonitis, cloudy swelling of heart, liver, and kidneys. Typhoid ulceration of ileum and colon, with perforation 1 cm. in diameter in descending colon, and echinococcus cyst of left lung.

CASE LXIV—*Perforation Operation Death*

Male, white, printer, aged twenty-eight years, hospital No 2974, admitted December 21, 1905, on the seventh day of disease, with a severe infection, a positive Widal, and 1050 leucocytes. Had had typhoid 8 years before and was confined to bed two months with it. Patient was very sick from the time of his admission, pronounced toxæmia, five hemorrhages from fourteenth to eighteenth days, totalling 63 ounces, condition very poor. On eighteenth day became worse, with tenderness in the right iliac fossa, increased distention without pain or rigidity. No change in liver dulness. After a few hours' interval tenderness had increased with slight rigidity, but no active pain. Perforation diagnosed. Operation, ethyl-chloride-ether anæsthesia, a very small recent perforation found about 12 inches above the ileocæcal valve which was closed and another pre-perforative ulcer was invaginated. No peritonitis, very little soiling of cavity, no drainage. Owing to poor condition shock of operation marked, never regained consciousness, death resulting in a few hours.

CASE LXV—*Perforation Operation Death*

Female, white, housework, aged twenty-one years, hospital No 3587, admitted February 13, 1906, on the fifth day of a moderately severe infection which became protracted, with a positive Widal and 3500 leucocytes. Had moderate distention after admission but was uncomplicated until thirty-third day, when she complained of rather severe abdominal pain, had a chill with marked acceleration of pulse (92 to 140), respiration 20 to 28, and a 3-degree elevation of temperature. Pain was in the region

of the bladder and she had frequent micturition with vesical tenesmus. Lower abdomen became rigid and she vomited. Was catheterized, 18 ounces obtained, which seemed to relieve the pain. During the next 24 hours not much change in condition. Abdominal symptoms not marked. Operation 48 hours after onset of pain, ethyl-chloride-ether anæsthesia, right rectus incision, general purulent peritonitis, and perforation found  $\frac{1}{8}$  of an inch in diameter  $3\frac{1}{2}$  feet above the ileocæcal valve which was closed, gauze drainage, Murphy treatment instituted. Two days later vomiting, great distention, and death on the third day after operation. No autopsy.

CASE LXVI—*Perforation Death Autopsy*

Female, colored, housework, aged thirty years, hospital No 3658, admitted February 19, 1906, on the twenty-first day of the disease, with a severe infection, a positive Widal, and 6200 leucocytes. Was profoundly toxic with irregular remitting temperature most of the time. On twenty-third day she suddenly became worse, pulse could not be counted with accuracy (went from 120 to 140?), abdomen distended, no note of pain, tenderness, or rigidity. Perforation not suspected. Increasing toxæmia and death on the twenty-fifth day. Autopsy, typhoid ulceration of ileum and colon, one perforation, 1 cm. in diameter, found 50 cm. above the ileocæcal valve and a second large perforation found a "little nearer" the ileocæcal valve. Cloudy swelling of heart, liver, and left kidney. Diffuse purulent peritonitis, thrombosis internal iliac vein and acute bronchopneumonia.

CASE LXVII—*Perforation Death Autopsy*

Female, white, housework, aged twenty-one years, hospital No 3679, admitted February 21, 1906, on the ninth day of disease, with mild infection, a positive Widal and 6800 leucocytes. This patient ran a mild course until the sixteenth day when she began to have hemorrhages. On the eighteenth day she had 9, varying in amounts of 4 to 16 ounces. During this 12 hours she had 4 pints of salt solution intravenously at one time, and  $3\frac{1}{2}$  pints at another time. Before this she was almost exsanguinated. Improved after salt solution and had no more hemorrhages. Pulseless before infusion. Pulse 3 days later (twenty-first day), 120 to 128, when she developed abdominal pain, tenderness, and rigidity in right rectus, expression pinched, no marked circulatory change. Twenty-four hours later vomited, pulse 120 to 140. On twenty-third day vomited all nourishment, "fecal in odor once," no pain. Twenty-fifth day, occasional vomiting, good bowel movement, pulse 128 to 150, better quality, no abdominal pain or tenderness. No abdominal tenderness or dis-



tention with two or three formed bowel movements Twenty-seventh to thirty-first day she became much worse with signs of bronchopneumonia, and died on the thirty-second day Autopsy Diffuse purulent peritonitis, perforation about 1 mm in diameter and 10 cm above the ileocæcal valve, extensive ulceration of the ileum and cæcum Cloudy swelling of heart, liver, and kidneys Bilateral purulent pyelonephritis, purulent cystitis, broncho-pneumonia, and thrombosis of both internal iliac veins

CASE LXVIII—*Perforation Operation Death*

Male, white, bell-boy, aged sixteen years, hospital No 3735, admitted February 26, 1906, on the sixth day of disease, with a severe infection, a positive Widal, and 10,100 leucocytes Leucocytes on the ninth day were 8900, on the eighteenth day 14,600, on the twentieth day 15,700 by two counts Complained of pain in delirium, diffuse tenderness over lower abdomen, marked distention Slight rigidity 12 hours before operation which increased, diminished peristalsis, audible abdominal breath sounds, obliterated liver dulness, cyanosis, gradual shock Operation, local and ethyl-chloride-ether anæsthesia, perforation, one-eighth of an inch in diameter and about 10 inches above the ileocæcal valve, sutured, abdomen irrigated, gauze drainage, enteroclysis and elevation Did well for two days after operation, abdomen became soft and no longer distended Suddenly became worse, abdominal pain, rigidity, distention, collapse, and death at end of third day No autopsy (probably, a second perforation)

CASE LXIX—*Perforation Operation Death Autopsy*

Male, white, laborer, aged thirty-two years, hospital No 3753, admitted February 27, 1906, on the ninth day of disease with a moderately severe infection, a very suggestive Widal, and 4000 leucocytes On twenty-second day leucocytes were 8400, and twenty-fifth day, just before operation, 7100 On admission patient complained of right iliac pain and tenderness, had some rigidity at this time which was thought to be voluntary Had persistent febrile course, 102 to 104°, without severe toxæmia Temperature normal on twenty-third day, remaining 97 to 98.2° after this Patient complained daily of pain in the abdomen which he referred to the right iliac fossa Was always tender and slightly rigid over this area from time of admission His pulse was 84 to 112 from the twenty-third to the twenty-sixth day, with temperature normal, but he persistently complained of pain and tenderness On the twenty-sixth day his condition became worse, without elevation of temperature, and he was operated upon, ethyl-chloride-ether anæsthesia, right rectus incision Cloudy fluid on opening the peritoneum, seemed to have

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a walled-off leaking abscess, which was drained without breaking adhesions to locate perforation. Five days later free fecal discharge from wound, temperature normal and subnormal, pulse 120, not doing well. Death suddenly on the seventh day after operation. Death thirty-second day. Autopsy. General fibrinopurulent peritonitis, ulceration of the ileum and jejunum, two small perforations, the first at the junction of the ileum and jejunum, and the second in the jejunum just above the juncture, swelling of mesenteric lymph-glands, acute vegetative endocarditis, cloudy swelling of liver and kidneys, chronic perisplenitis, chronic adhesive pleurisy.

### CASE LXX—*Perforation Death Autopsy*

Male, white, watchman, aged forty-three years, hospital No 4098, admitted March 29, 1906, on the fourteenth day of disease with a severe infection, a positive Widal, and 3300 leucocytes. Leucocytes at supposed time of perforation were 7600. Patient very sick from time of admission with repeated hemorrhages, fourteenth to eighteenth days, totaling nearly 80 ounces. Condition very poor after this. Had signs of considerable bronchitis and possible bronchopneumonia after this, and on thirty-second day began to complain of pain, abdomen tender, rigid, and distended, with rapid circulatory failure. On thirty-third day perforation was diagnosed but too weak for operation. Death 12 hours later. Autopsy. General peritonitis, perforation of ileum, cloudy swelling of heart, liver, and kidneys, lobar pneumonia left base, and fibrinopurulent pleurisy.

### CASE LXXI—*Perforation Operation Death*

Male, colored, laborer, aged twenty-seven years, hospital No 4450, admitted April 24, 1906, on the twelfth (?) day of the disease, with a severe infection, a suggestive Widal, and 4600 leucocytes. Later leucocytes were 6950. On admission (48 hours before operation) complained of abdominal pain, tenderness in the right iliac fossa, abdominal distention and liver dulness almost obliterated. These symptoms persisted. Had another attack of pain 24 hours after admission with increasing toxæmia. Says abdomen feels as if splinter was being stuck in over McBurney's point. Liver dulness absent in nipple line (8 hours after admission). Patient had urinary difficulty to-day, has vomited two or three times with rapid pulse, rise of temperature, and increasing toxæmia. Patient had two hemorrhages before admission and two after admission. Operation, ethyl-chloride-ether anæsthesia about 60 hours after admission, three perforations, the first pin-point in size and 12 inches from the ileocæcal valve, the

second, 2 mm in size and 15 inches from the ileocæcal valve, and the third, 6 mm in size and 24 inches from the ileocæcal valve. General peritonitis, marked effusion of intestinal contents, perforations sutured, gauze drainage, Fowler position, enteroclysis. First perforation probably 48 hours before operation, large perforation probably at time of vomiting, just before operation. Death 4 hours later. No autopsy.

CASE LXXII—*Perforation Operation Death Partial autopsy*

Male, white, laborer, aged twenty years, hospital No 643, admitted May 26, 1906, with a severe infection, a positive Widal, and 7700 leucocytes. Leucocytes 5 hours after pain 15,900, 6 hours after, 16,300. This patient was admitted on the sixth day of disease, had sudden recurrent paroxysms of pain with abdominal tenderness which persisted between paroxysms, with persistent desire to urinate. Right lower rectus rigidity which gradually increased. Peristalsis lessened, audible abdominal breath sounds. Shock attended onset of pain and was attributed to tub which was being given at onset of pain. No vomiting. Operation refused at first but was done 10 hours after pain, ethyl-chloride-ether anæsthesia. Perforation, pin-head in size, found 15 inches from cæcum and closed, gauze drainage, moderate extravasation of intestinal contents, cavity irrigated. Patient did well from surgical stand-point, but died 7 days after operation from toxæmia and pneumonia. Autopsy through wound. Perforation had healed, peritonitis had subsided, and no other perforation had occurred.

CASE LXXIII—*Perforation Operation Death Autopsy*

Male, white, policeman, aged forty years, hospital No 737, admitted June 3, 1906, on the tenth day of disease, with an ambulatory infection, positive Widal, and 7280 leucocytes, counted just before operation. Patient said he had had a cold for 10 days, no diarrhœa, epistaxis or chills. Thirty-six hours before admission severe headache, general weakness, pain in abdomen, and vomiting when he went to bed. Referred to the hospital as appendicitis. Abdomen slightly distended with generalized tenderness and rigidity, more marked in the right iliac fossa. Operation, ethyl-chloride-ether anæsthesia, right rectus incision, purulent peritonitis with much fecal matter, perforation, 2 mm in size and about 5 inches above the ileocæcal valve, closed, salt solution irrigation, rubber tube and gauze drainage. Death 15 hours later. Autopsy. Typhoid ulceration of bowel, general peritonitis, no other perforation.

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### CASE LXXIV—*Perforation Operation Death*

Male, white, laborer, aged thirty-five years, hospital No 1035, admitted June 28, 1906, with a history of having been sick 9 days with headache, fever, and abdominal pain. Epistaxis and cough. Two days before admission patient was seized with severe cramp-like abdominal pain and vomiting. On admission abdomen was greatly distended with diffuse tenderness and marked generalized rigidity. No record of Widal or leucocyte count. Operation soon after admission under ethyl-chloride-ether anæsthesia, right rectus incision. On opening the peritoneum there was a free escape of purulent material mixed with fecal matter. A small perforation was found in the ileum a few inches' above the ileo-cæcal valve and was closed with a purse-string suture. Gauze drainage instituted, abdomen partially closed, patient gradually failed and died 24 hours later.

### CASE LXXV—*Perforation Operation Recovery*

Male, white, bartender, aged nineteen years, hospital No 1601, admitted August 14, 1906, on the seventh day of a moderately severe typhoid with a positive Widal and 8800 leucocytes. He had moderate distention of the abdomen soon after admission but the course of the disease was uncomplicated up to the twentieth day, when, after a good night, and immediately after taking a drink of water, he had severe sharp pain in the abdomen with a chill, rapid weak pulse, tenderness in the left iliac fossa, slight muscular rigidity, audible breath sounds over the abdomen, diminished peristalsis with costal breathing, and 50 per cent increase in his respiratory rate with considerable shock. His temperature immediately dropped 3 degrees with a secondary rise. Leucocyte count at the onset of pain was 5700, two hours later, 4800, three hours after onset of pain, 4100, and four hours after onset of pain, 7200. Operation 4 hours after onset of pain under ethyl-chloride-ether anæsthesia, right rectus incision. On opening the peritoneum it was found there had been considerable escape of intestinal contents. A perforation was found, pin-head in size, in the ileum, 11 inches from the ileocæcal valve. It was closed, the wound drained with gauze and Murphy treatment instituted. Stood the operation well. His leucocytes were counted 3 hours after the operation and were 6300, 6 hours after operation they were 7400, 8 hours after operation they were 8500. On the fifth day after operation he had a hemorrhage of 9 ounces from the bowels. His temperature continued irregular but not high for 17 days after the operation. After this his recovery was uneventful.

CASE LXXVI—*Perforation Operation Death*

Male, white, laundryman, aged thirty-seven years, hospital No 1618, admitted August 16, 1906, on the fourteenth day of a rather severe infection with a positive Widal and 4200 leucocytes. There were no complications until the thirty-fourth day, but during all this time his temperature had been moderately high and persistent. On the thirty-fourth day he developed severe abdominal pain, his pulse was almost imperceptible, and he had a severe chill, with considerable shock. His respirations were increased, his temperature immediately became elevated 4 degrees over his previous temperature, with abdominal tenderness and rigidity. He was seen by a surgeon 24 hours later and operation advised, which was done under ethyl-chloride-ether anæsthesia. A general peritonitis was found with a perforation in the ileum 14 inches above the ileocæcal valve (size not stated). Perforation closed, gauze drainage, enteroclysis given, and patient placed in Fowler position. Patient died on the fourth day after operation, probably as a result of peritonitis. No autopsy.

CASE LXXVII—*Perforation Operation Death*

Male, white, laborer, aged twenty-eight years, hospital No 1988, admitted September 21, 1906, on the sixteenth (?) day of disease, with an ambulatory infection and no record of Widal or leucocyte count. Temperature was 103° on admission. Had been sick for two weeks but walked around. On night before admission acute abdominal pain, tenderness, sent to the hospital with a diagnosis of acute appendicitis. Operation, ethyl-chloride-ether anæsthesia, peritonitis (general) present, perforation, 3 mm in diameter about 8 inches from cæcum, closed, abdomen drained, bed elevated, and enteroclysis given. Died 3 days after operation (Notes very incomplete).

CASE LXXVIII—*Perforation Operation Death*

Female, white, housework, aged fifty-three years, hospital No 2395, admitted October 28, 1906, on the twenty-third day of disease, with a mild infection, a positive Widal, and 5150 leucocytes. Patient had slight abdominal pain and vesical tenesmus and tenderness 3 hours before chill. Chill was severe with marked increase of pulse (96 to 132), abdominal pain, tenderness, and slight rigidity (lower right quadrant), anxious expression, said she was going to die. Not seen by a surgeon for 12 hours. Had hemorrhage 3 days before perforation and liver dulness almost obliterated. Operation about 12 hours later, large perforation, 3 mm in diameter, 8 in from cæcum, patient collapsed on the table. Perforation closed, abdomen irrigated, drainage instituted. Death 12 hours after operation. No autopsy.

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### CASE LXXIX—*Perforation Death Autopsy*

Male, white porter, aged twenty-six years, hospital No 2415, admitted October 31, 1906, on the eleventh day of disease, with a severe infection, a positive Widal, and 8100 leucocytes. Had a persistent fever,  $102^{\circ}$  to  $103^{\circ}$ , considerable toxæmia, hemorrhages on nineteenth day (had 5 hemorrhages, totaling 44 ounces, nineteenth to twenty-first days inclusive), increasing toxæmia, and abdominal distention. No pain, tenderness, or rigidity noted day before death (twenty-second day). On twenty-first day had chill and subsequent elevation of temperature. Pulseless (day of death), cold, drop in temperature, death. Autopsy: Two perforations, one 30 cm from ileocæcal valve and another 2 cm from ileocæcal valve (non-adherent). Ileum at site of perforation adherent to bladder with the additional non-adherent perforation. Localized peritonitis, congestion of the lungs and kidneys, fatty degeneration of liver, swelling of lymph follicles with extensive ulceration. Perforation not diagnosed and probably not suspected.

### CASE LXXX—*Perforation Operation Death Autopsy*

Male, white, motorman, aged twenty-eight years, hospital No 2603, admitted November 17, 1906, on the eighth day of disease, with a severe infection and no record of Widal or leucocyte count. He had moderate diarrhœa with abdominal distention from the time of his admission. On the twelfth day he developed severe sudden pain with tenderness and marked general rigidity. The breath sounds were audible over his abdomen, liver dulness was obliterated, but there was no change in his pulse or respiratory rate and no change in temperature, which had been taken hourly. His leucocytes at onset of pain were 6450, 3 hours later 3800, and 8 hours later 9000. Operation, ethyl-chloride-ether anæsthesia, general peritonitis present with one perforation, pin-head in size, in the ileum 18 inches from the ileocæcal valve. Perforation was sutured, gauze drainage, Murphy treatment instituted. Patient did well without untoward symptoms from time of operation until November twenty-sixth, when his abdomen became distended, pulse very much accelerated, restless, obliteration of liver dulness and death 12 hours later. Autopsy: General purulent peritonitis, with sloughing of enterorrhaphy and another perforation in the ileum 8 cm above the ileocæcal valve. Bronchopneumonia, cloudy swelling of the heart, liver, and kidneys, acute splenic tumor, extensive ulceration of the ileum. Autopsy culture from lung, liver, gall-bladder, and spleen showed the bacillus typhosus, and cultures from peritoneal exudate showed the bacillus proteus.

CASE LXXXI—*Perforation Operation Death Autopsy*

Male, white, salesman, aged twenty-four years, hospital No 2705, admitted November 27, 1906, on the twenty-first (?) day of disease, with an ambulatory infection, a positive Widal, and no record of a leucocyte count. Admitted about 24 hours after onset of sudden paroxysmal pain (recurring), liver dulness gone, marked distention, great tenderness and general rigidity. No vomiting until 20 hours after onset of pain. Peristalsis heard with difficulty, breath sounds audible over abdomen. Operation, ether anaesthesia. Perforation, small, 12 inches from cæcum, sutured, abdomen flushed, and gauze drainage. Death third day after admission. Autopsy. General peritonitis, two secondary perforations, one beside the original and another 4 cm above the original, the original sutures having held. Cloudy swelling of heart, liver, and kidneys. Pleurisy and bronchopneumonia. Perforation occurred before admission to the hospital.

CASE LXXXII—*Perforation Operation Death*

Male, white, laborer, aged twenty-six years, hospital No 2949, admitted December 20, 1906, on the eighteenth (?) day of disease, with a moderately severe infection, a suggestive Widal, and 3700 leucocytes. Five days later at the onset of pain leucocytes were 11,000, and six days later, 13,000. On the twenty-third day patient had sudden sharp pain, paroxysmal, recurring and abating two or three times. Later, less severe but continuous with a 15-degree elevation of temperature. Marked localized tenderness and rigidity in lower right quadrant which became generalized. Fifteen hours later no pain but marked tenderness and general rigidity. During one minute auscultation no peristalsis heard. Dorsal-decubitus position. Patient's pulse and respirations were increased 25 per cent at onset of pain over the highest count on the same day previous to onset. Operation, ethyl-chloride-ether anaesthesia, which had been refused until 20 hours after onset of pain. General peritonitis found with pin-head perforation in the ileum, 8 inches above the ileocaecal valve. Perforation closed, abdomen drained with gauze, and Murphy treatment instituted. Death 4 days after operation, probably from peritonitis. No autopsy.

(*To be continued*)

# THE TREATMENT OF JOINT INFECTIONS BY LAVAGE AND DIRECT MEDICATION

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DURING the past two years, in the wards of the New Haven Hospital and in the Laboratory of Surgery of Yale University, attempts have been made to apply to certain surgical infections, in particular those of the joints, some of the recent findings of chemotherapy. These studies received their stimulus from, and were based upon, observations made and published during 1912, 1913 and 1914 on the selective bactericidal action of gentian violet. The immediate significance of these early observations was in the field of bacteriology, but it soon became evident that they led into many fields and that they offered a promising clew in the field of practical therapy. It was equally evident, however, that no *immediate* transfer of the observations to the treatment of disease was possible, and that the observations were of practical value only as indicating the direction which subsequent experiments should take.

*The Selective Bactericidal Action of Gentian Violet*—The first observation, on which the subsequent work rested, was that gentian violet possessed a sharp and constant selective, bactericidal property.<sup>1</sup> This property was at first demonstrated by staining the organism and transplanting it to the surface of agar slants. When this was done it was found that one group of organisms when stained grew as well as when unstained, while another group of organisms failed when stained to grow at all (see Figs. 1 and 2). The organisms which failed to grow when stained were referred to in the early publications as violet positive, those which grew when stained, as violet negative.\* A simpler method of demonstrating this selective property of the dye and of further studying it was promptly devised. Agar plates were so poured that one-half contained plain agar while the other contained agar to which gentian violet had been added. Across these plates the organism to be tested was stroked, and the selective power of the dye manifested itself in a sensational way. Violet positive organisms refused to grow

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\* Or, better, gentian positive and gentian negative



on gentian violet agar or in its neighborhood, violet negative organisms grew equally well on the two sides of the plate (see Figs 3, 4 and 5) This reaction was sharp and constant and its sensitiveness is indicated by the fact that the gentian violet in the plates from which Fig 3 and Fig 4 were made was only in the strength of one to one hundred thousand, while similar results were obtained in many of the experiments with much weaker solutions

*Parallelism of Gentian Reaction and Gram Reaction*—By this method of inoculation on divided plates the original study of the commoner organisms was extended to include three hundred and thirty-four strains representing one hundred and thirty-eight distinct bacterial species The results showed, as the original observations had suggested, that bacteria can be pretty sharply divided into two groups according as their growth is or is not inhibited by gentian violet The additional interesting fact was brought to light that the gentian violet reaction runs roughly parallel to the Gram reaction It was found that the large majority of Gram positive organisms are also gentian positive, and the large majority of Gram negative organisms, gentian negative The actual figures are as follows

		Violet positive		Violet negative	
130 species	{ Gram positive, 77	70 (90 + per cent )		7 (9 + per cent )	
	{ Gram negative, 53	8 (15 + per cent )		45 (84.9 + per cent )	
		Violet positive		Violet negative	
318 strains	{ Gram positive, 182	165 (90 per cent )		17 (9.3 per cent )	
	{ Gram negative, 136	15 (11 per cent )		121 (88.9 per cent )	

To this parallelism there were, as the table indicates, a number of exceptions, and later observations of Winslow showed that a study of the Gram negative cocci would probably increase the number of exceptions However, making allowance for these facts and for the notorious uncertainty of the Gram stain, the parallelism between the two reactions remains sufficiently striking

*Isolation of Pure Cultures by the Method of Divided Plates*—It was next shown that, by the method of inoculation on divided plates, isolation of gentian negative organisms in pure culture out of mixtures with gentian positive organisms could be readily accomplished Such an isolation of *B typhosus* in pure culture out of a mixture with *B subtilis* and *M aureus* is illustrated in Fig 6, and Petroff working in Trudeau's laboratory has recently been able, by the use of gentian violet in a modification of the method here described, to isolate *B tuberculosis* in pure culture from the stools This is the first time that such isolation has been successfully accomplished

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Many of the organisms which float in the air belong in the Gram positive—and hence in the gentian positive group—and it is a matter of a good deal of importance to bacteriology that these organisms which cause so much trouble, as air contaminators, fail to grow in the presence of the dye. That they do so fail to grow is shown in Fig 7.

That some of the aniline dyes are capable of injuring certain animal cells has long been known. In 1890 Stilling published a Strassburg thesis<sup>2</sup> on the antiseptic action of aniline dyes with particular reference to pyoktanin (probably a mixture of several dyes), but he failed to observe any selective action of the dyes, and made wholly unwarranted claims for its bactericidal property, which led to unwise clinical use and subsequent disrepute. The important lead obtained in 1902 by Drigalski and Conrad<sup>3</sup> as to the selective bactericidal action of crystal violet was not, owing to the chief interest of these authors in the cultivation of *B. typhosus*, followed up by a systematic study of the dye. The observations reported in my early publications, therefore, while not entirely without precedent, call attention to a number of points not previously observed. These points may be summarized as follows:

- 1 The reaction of an organism to gentian violet, when planted on a divided plate, is a characteristic as easy to determine, as constant, as clear cut, and as significant as any known mark by which bacteria are identified. The Gram stain is not to be compared with it as regards definiteness or constancy. It fails to be of value in the case of the small number of organisms (*e g*, pneumococcus, *Diplococcus gonorrhoea*) which will not grow well on plain agar, or whose slight growth is inhibited by almost any change in the media. For a small group of organisms the reaction is not absolutely constant and therefore, in their case, not altogether satisfactory.

- 2 The isolation of gentian negative organisms from mixtures with those which are gentian positive is readily accomplished by transplantation on divided plates.

- 3 In the same way, cultures of gentian negative organisms may readily be freed of air contaminations.

- 4 The transplantation on divided plates may be of assistance in demonstrating the presence of a contamination in a supposedly pure culture.

*Action of Gentian Violet on Closely Related Bacterial Strains*—It was not expected from these early studies that closely related organisms would differ in their behavior toward gentian violet, and it was found, by a study of the effect of the dye on one hundred and thirty-eight distinct bacterial species, that nearly allied organisms were, in general,

similarly affected by the stain. In a study, however, of five nearly identical strains, belonging to the enteritidis group, the selective affinity of the stain was found to be so specific in character as to distinguish between different strains of very closely related organisms.<sup>4</sup> Though these five organisms were identical in their reaction to all the ordinary bacteriological tests, gentian violet constantly inhibited one member of the group while on the growth of the other four it was absolutely without effect (see Fig 8). This observation was not only of significance for bacteriology, but also showed how cautious one must be in generalizing as to the effect of a chemical on closely related organisms, and illustrated in a quite simple way the well-known phenomenon of "fastness."

*Toxicity of Gentian Violet and Its Fate in the Animal Body*—These observations of bactericidal properties possessed by gentian violet, and particularly of the affinity of this dye for pyogenic organisms, made it important to determine its toxicity and its fate in the animal body.<sup>5</sup> This was done by intravenous injections of the dye into rabbits, very strong solutions and large doses being used. Though a few of the experimental animals died in convulsions immediately after the injections, most of the animals were found to tolerate enormous doses of the dye in the circulation and to remain perfectly well. Prompt and fairly deep staining of the mucous membranes took place, but the most important fact brought out by this study was the rapidity with which the animal changed the dye into some substance not possessing the selective bactericidal property. This was demonstrated by injecting gentian violet intravenously and then making divided plates with blood withdrawn from the ear at varying intervals. In the plate made immediately (see Fig 9) the usual selective action of the dye manifested itself, and this was also true of the plate made after three-quarters of an hour (see Fig 10), though here the reaction was not quite so sharp. At one and three-quarter hours, however, the blood had entirely lost its selective bactericidal property (see Fig 11). The importance of this observation in any attempts to apply aniline dyes to the treatment of infection by injection into the circulation, is too obvious to need more than mention.

*Effect of Staining with Gentian Violet on the Bacteria*—The changes wrought in the injected dye by the animal organism led also to studies of the changes produced in the bacteria.<sup>6</sup> The purpose of these studies was to determine particularly whether gentian positive organisms when deeply stained might, by throwing off the stain or in some way changing it, survive if placed in the most favorable environment.

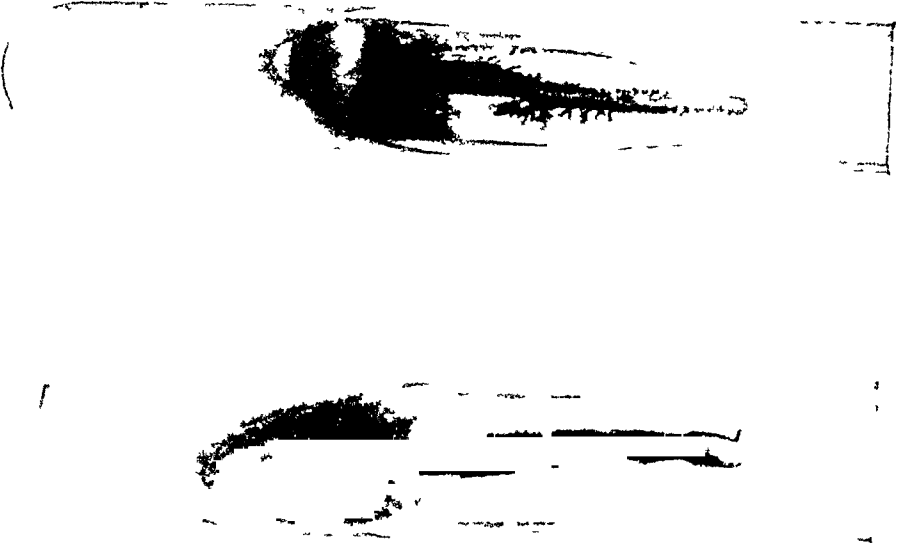


Fig 1—The tube on the left was inoculated with *B. prodigiosus* for control, that on the right with *B. prodigiosus* which had been stained for one hour with gentian violet. Note that the growth of the stained organisms was unaffected by the dye. Compare with Fig 2

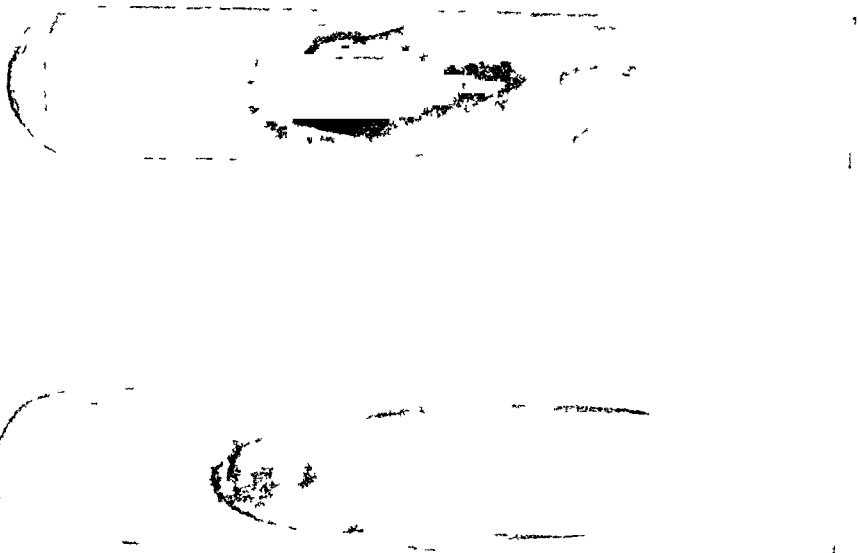


Fig 2—The tube on the left was inoculated with *blastomyces* for control, that on the right with *blastomyces* which had been stained for one hour with gentian violet. Note that the growth of the stained organisms was completely inhibited by the dye. Compare with Fig 1



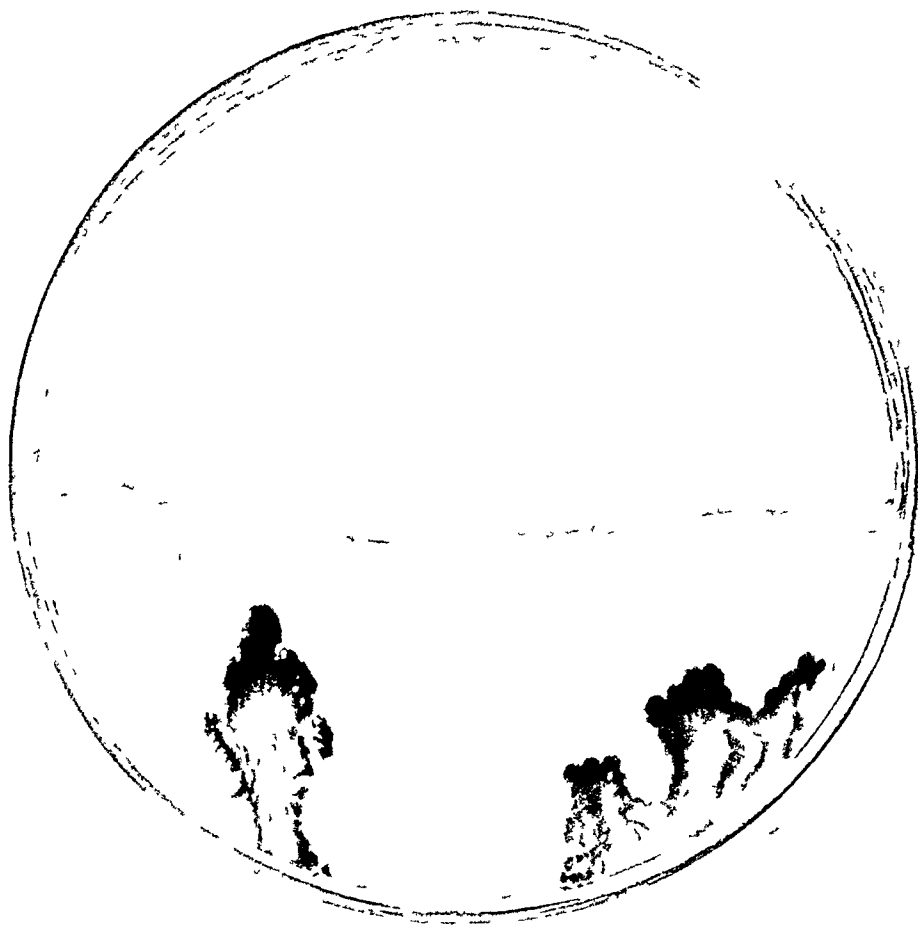


FIG. 3 —The plate has been stroked with an emulsion of *sarcina rosea*. The growth refuses to approach the dividing line. Note the mark of the inoculating needle in the gentian violet agar which contains the dye in a strength of 1-100 000. Notice the diffusion of the strain into the plain agar across the dead line. Compare with Fig. 4.



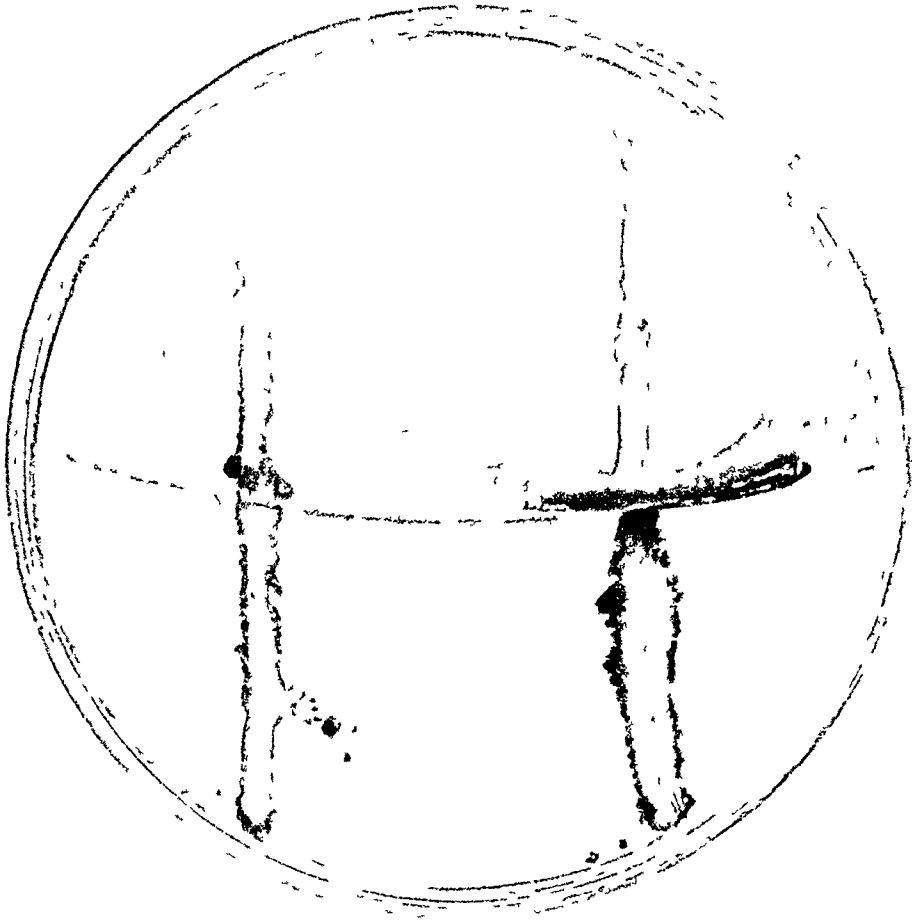


FIG 4—The plate has been stroked with an emulsion of *B. prodigiosus*. Growth has been uninfluenced by the dye. Note the staining of the growth on the gentian violet half of the plate. Compare with Fig. 3.





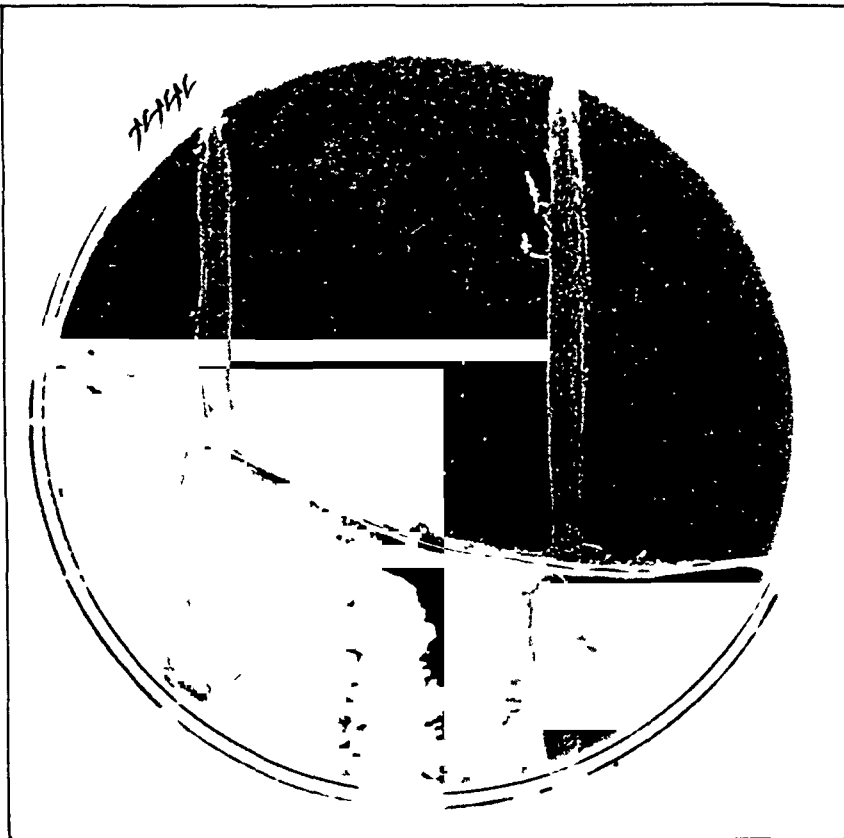


FIG 5 —Two stroke cultures of *B. prodigiosus* have been made on this plate separated by a stroke culture of *B. subtilis* the selective action of the gentian violet (in the upper half of the plate) being thus clearly demonstrated. *B. subtilis* refuses even to approach the dividing line, while *B. prodigiosus* grows equally well on the two sides.

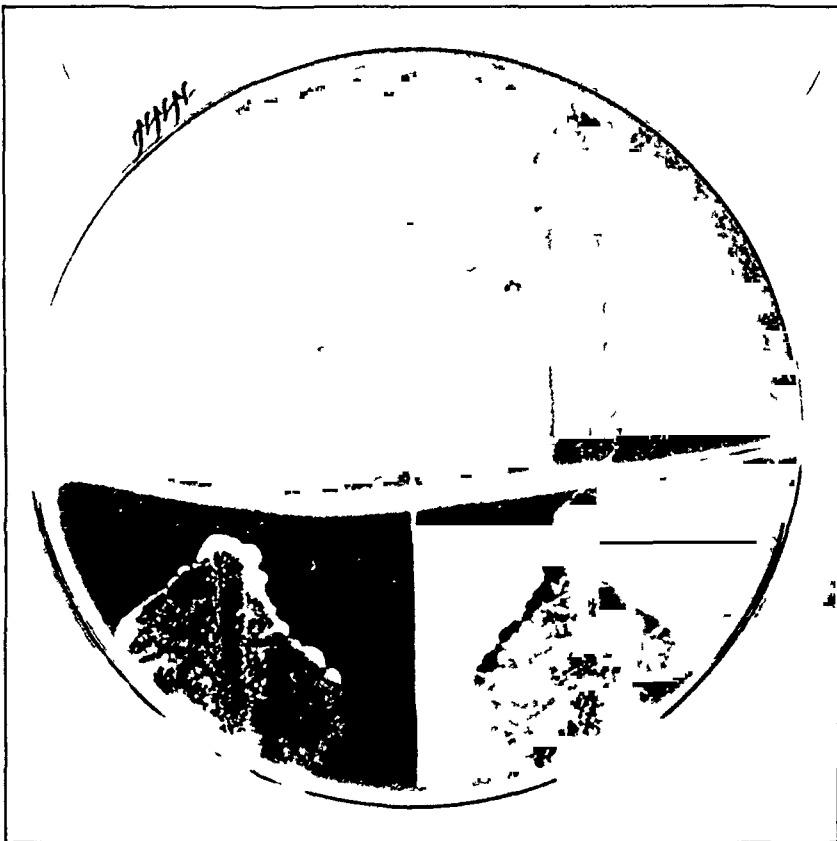


FIG 6 —The left half of the plate has been stroked with a mixture of *B. subtilis* and *M. aureus*. The luxuriant growth in the plain agar ceases sharply some distance from the dividing line and the edge of the growth is seen to be stained by the dye which is diffused across the line. On the gentian violet agar there has been no growth whatever. The right half of the plate has been stroked with the same mixture plus *B. typhosus*, and at the point where the growth of *B. subtilis* and *M. aureus* ceases a pure culture of *B. typhosus* is seen to start crossing the line and growing well on the gentian violet agar.

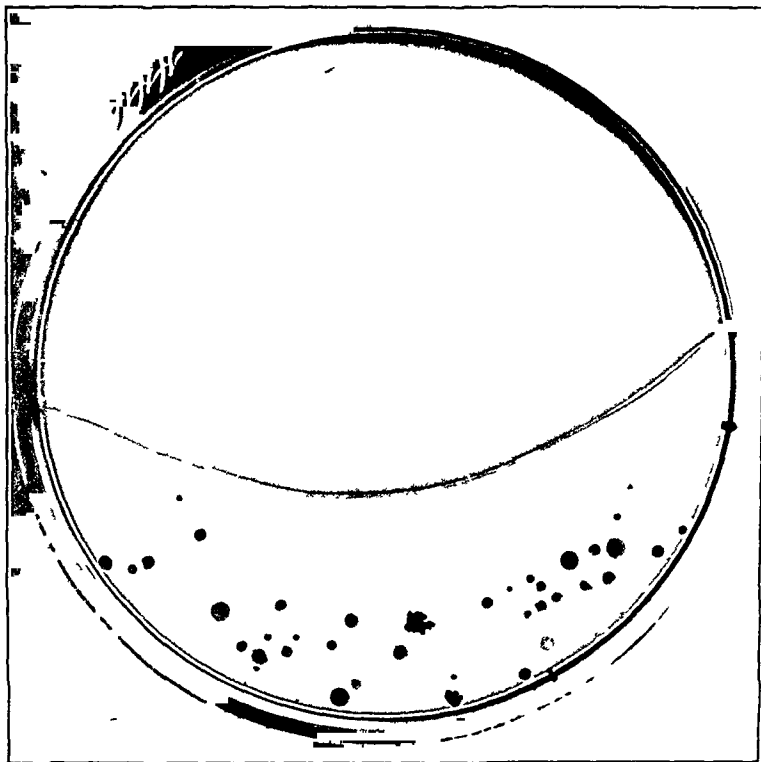


FIG 7—This plate was exposed before an open window for one hour on a rainy day. All the air contaminations have grown on the plain agar half none on the gentian violet half

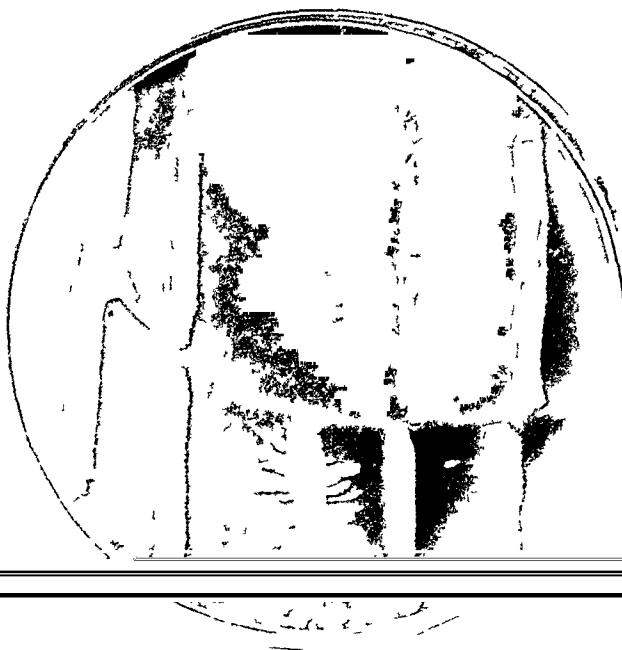


FIG 8—The plate has been stroked with 5 strains of *B. enteritidis* identical in their behavior to all the bacteriological tests. It will be seen that one strain refuses to grow in the presence of gentian violet while the growth of the other four is uninfluenced by the dye

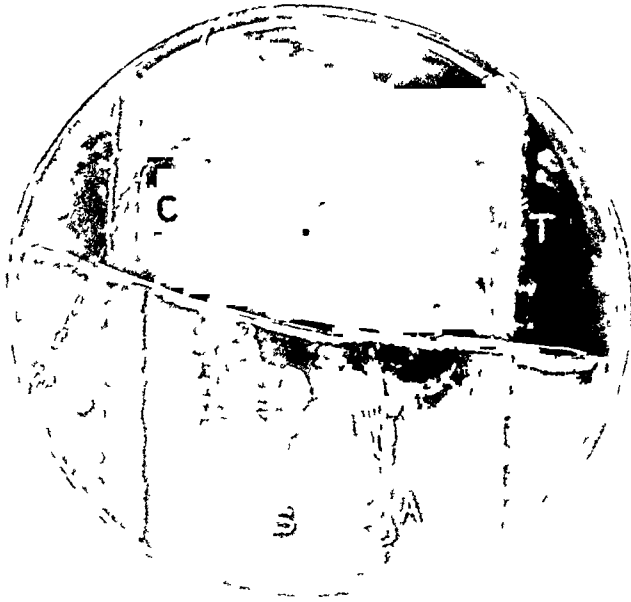


FIG 9 —Divided plate made with blood withdrawn from the heart of an animal which had received 10 c c of a 1 to 200 solution of gentian violet intravenously. Blood withdrawn and plate made immediately after injection of the dye. Organisms used were *B coli*, *B subtilis*, *M aureus*, and *B typhosus*. Selective bactericidal property of the dye present.

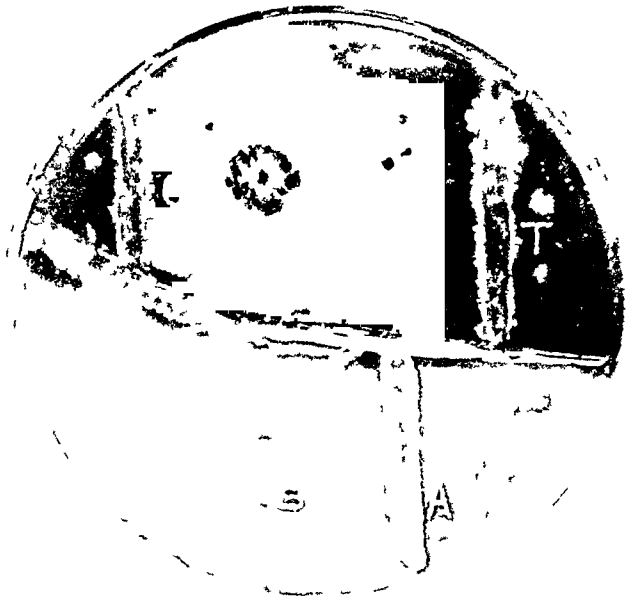


FIG 10 —The same as FIG 9 except that blood was withdrawn and plate made three-quarters of an hour after injection of the dye. Selective bactericidal property of the dye still present.

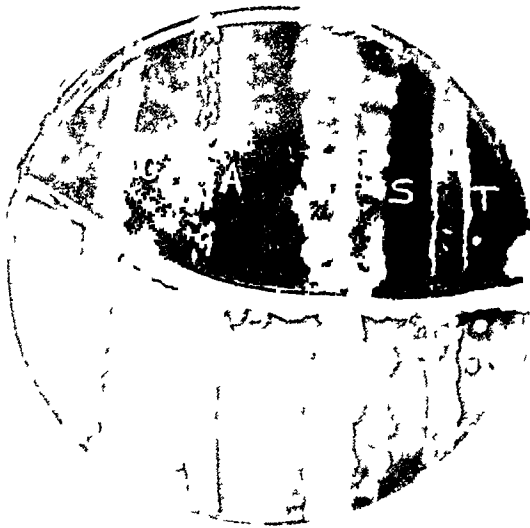


FIG 11 —The same as Fig 9 except that blood was withdrawn and plate made one and three-quarters hours after injection of the dye. Selective bactericidal property of the dye has disappeared.

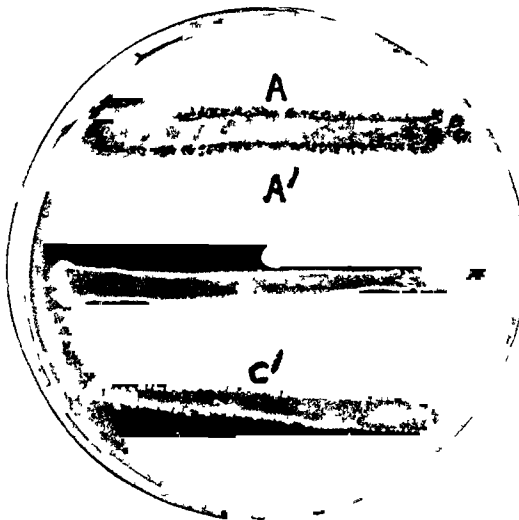


FIG 12 —Showing that methyl violet possesses a selective bactericidal property like that of gentian violet. The plate is a plain agar one. It has been stroked (A and C) with unstained *B. anthracis* and *B. coli* for control, and also (A' and C') with stained *B. anthracis* and *B. coli*. The former has been killed; the latter is unaffected by the dye.

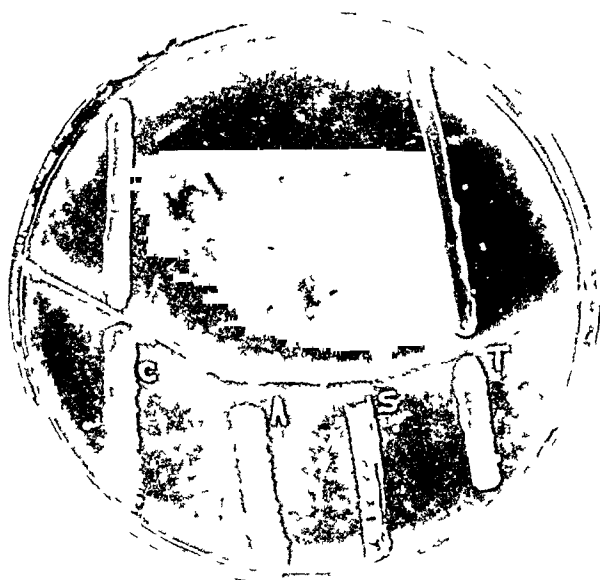


FIG 13 —Showing that crystal violet possesses a selective bactericidal property like that of gentian violet. The upper half of the plate contains crystal violet agar. It has been stroked with *B coli*, *B anthracis*, *staphylococcus* and *B typhosus*. The growth of two has been stopped, of the other two unaffected.

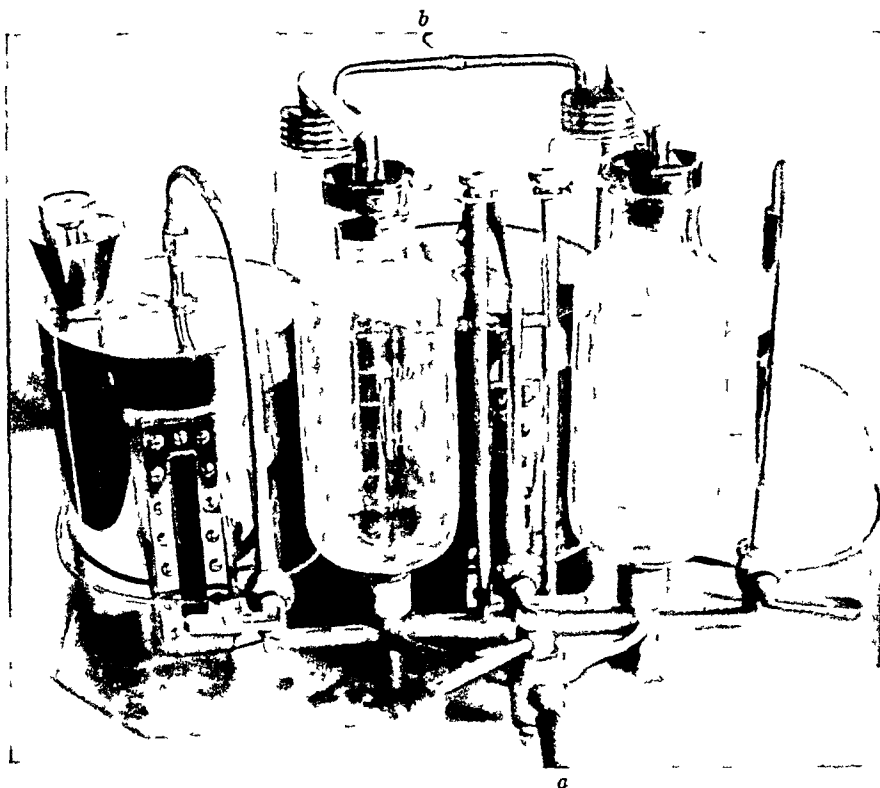


FIG 14 —Apparatus for irrigating joints and applying antiseptics. All stopcocks are readily removable for purposes of cleaning, as are also the covers of all bottles and reservoirs.



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within the animal body. It had already been shown that the gentian positive organisms when changed could not survive *in the environment of ordinary bacteriological media*. The first experiments in this direction were done with *M. aureus*. Emulsions of this organism were deeply stained and large doses injected into the ear veins of rabbits. The animals were in no way affected by the injection, though controls which received unstained organisms died promptly of staphylococcus septicaemia. Similar results were obtained with a species of blastomyces, especially suitable for experiments with guinea-pigs. With *B. anthracis* quite remarkable results were obtained. For the injections with this organism a highly susceptible animal (the mouse) was used and large doses of the organism employed. The controls died within forty-eight hours, with the usual findings in the heart's blood and spleen. But the animals receiving stained organisms, though not eventually surviving, remained perfectly well for periods varying from ten to twenty-five days, at the end of which time they died of anthrax septicaemia. Where the organisms which finally killed the animal were in the long interval of good health between injection and death, and why they did not cause death sooner, if they were to cause it at all, are highly important questions which further experimental study has as yet failed to answer satisfactorily.

It is interesting to note that Madame Henri has recently reported to the French Academy of Sciences similar results of experiments with *B. anthracis*. In these experiments guinea-pigs injected with the organism, which had previously been exposed to ultra-violet rays, survived for a long time but finally died of the disease, though in an atypical form. These results Madame Henri has rather hazardously interpreted as indicating a true mutation of bacteriological species under the influence of ultra-violet rays.

*The Selective Bactericidal Action of Stains Closely Allied to Gentian Violet*—An attempt made to determine which part of the gentian violet molecule was responsible for its sensitive selective affinity for bacteria led to a study of a number of other stains closely related to gentian violet in chemical structure.<sup>7</sup> Dahlia, parafuchsin, magenta, pararosanilin, rosanilin, crystal violet and methyl violet 5B were the dyes used, and they were found to possess the same selective bactericidal property as that exhibited by gentian violet (see Figs. 12 and 13).

*Effect of Gentian Violet on Enzymes, Toxins and Ultra-Microscopic Infections*—Experiments were next undertaken to determine the effect of the dye on enzymes, toxins and ultra-microscopic infections.<sup>8</sup> The original purpose of these experiments was to provide a new method of



studying ultra-microscopic infections, and to see if it might not be possible, by adding a dye to an infectious agent, to stain and thus to kill organisms too small to be seen. It was first, of course, necessary to show that toxins themselves were uninfluenced by the dye. An organized ferment (yeast) was first studied and its power to ferment sugar found to be lost after the yeast cells had been stained. Five organized ferments (pytalín, pepsin, trypsin, rennin and thrombin) were also studied in this way and their activity found to be unaffected by staining with the gentian violet. Staining of the diphtheria toxin also was found to impair in no way its toxicity. Of the ultra-microscopic infections, two were studied, vaccinia and infectious material from anterior poliomyelitis. The first of these was entirely unaffected by staining, with the second the results were inconstant.

*Effect of Gentian Violet on Protozoa and Growing Animal Tissue —*

The study was also extended to include observations of the effect of the dye on protozoa and on growing animal tissue.<sup>9</sup> The purpose of these experiments was to determine (*a*) whether the nucleus of a cell could be stained during life and (*b*) whether such a stained cell is capable of further reproduction. The commonly accepted notion is that nuclear stain is a certain sign of death, but both of the questions put were answered by our experiments in the affirmative. We were able, that is to say, to demonstrate that the nucleus could be stained by gentian violet during life, and succeeded, not only in growing animal tissue in media containing the dye, but also in observing the subdivision of cells whose nuclei were stained, as well as the subdivision of the stained nuclei themselves. These observations, which are recorded in Figs 14 and 15, demonstrate the fact that a highly diffusible dye like gentian violet, in contact with living cells, enters the nucleus during life and, though staining it, does not prevent its further growth. The importance of this fact, so far as the therapeutic use of stains is concerned, is obvious. It may also lead to a useful modification of the technic of cultivating tissue—by diminishing the risk of bacterial infection—to a facilitation of the study of nuclear growth, and possibly to providing a means for the isolation in pure culture of tissue from a mixture, through the selective action of dyes.

*Application to the Treatment of Infections —* These were the experimental studies which stimulated me to undertake clinical experiments, having for their purpose the application of the bactericidal activity of certain aniline dyes to some of the unsolved problems in the surgical treatment of infections. The only possible excuse for attempting to use gentian violet in this way, rather than one of the many well-known

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and efficient bactericides at hand, lies in the extreme diffusibility of the dyes, their relative harmlessness, and the fact that the presence of very weak solutions of the dye in media prevents the growth of a number of the commoner organisms of suppuration. It should be said at once that gentian violet is not absolutely non-poisonous nor absolutely non-irritant, and a careful study would probably prove the same statement true of other dyes, for which loose claims as to their harmlessness have been circulated. It is also evident that it would be absurd to expect any effect on organisms floating in the blood stream from gentian violet injected into the circulation. The experiments already referred to prove conclusively that the bactericidal property of gentian violet circulating in the blood stream soon disappears. Stilling, in his publications on pyoktanin, failed to investigate this point, and his failure was responsible for his extravagant claims for the dye. The point has also doubtless been equally overlooked by others in making statements about other dyes.

Both the irritant quality and the poisonous quality of gentian violet are, however, moderate, and this point having been determined by experiments on animals and human beings, it seemed advisable to begin attempts to use this highly diffusible bactericide on surgical infections, which owe their chronicity to the persistence of the organisms in the depths of tissue, where they cannot be reached by ordinary antiseptic agents. Infections of the joints and infections of the mucous membranes suggested themselves as the most promising fields of attack, and it is the early studies in the treatment of joint infections by this method which I wish to report here.

It is obvious that it would be absurd to expect, as Stilling did in his work with pyoktanin, that the simple introduction of a diffusible dye into an inflammatory area (for example, into an abscess) would be of any avail, for the dye in this case would either not come into contact at all, or only in a partial and casual way, with the frontier of the infection (for example, the abscess wall), where the hidden organisms responsible for the persistence of the infection are lodged. The difficulty of getting the dye into actual contact with the mucous membranes was shown by attempts made to treat a diphtheria carrier by painting the pharynx and tonsils with gentian violet. The diphtheria bacillus is constantly gentian positive, and I had shown by experiments on the joints, tongue and bladder that the living mucous membrane could be stained down to the underlying tissue by application of the dye to the surface. To attempt to reach

the organism in the depths of the mucous membrane by painting the pharynx and tonsils seemed, therefore, a rational procedure

The results were somewhat suggestive, but an unexpected obstacle was met in the secretion of the mucous glands of the pharynx. This material lay over the surface of the pharynx in a thin slimy layer, which was renewed by fresh secretion as rapidly as it was removed, and which prevented intimate contact between dye and mucous membrane as effectually as a layer of grease would have done. The observation was instructive as indicating some of the difficulties which will have to be overcome in attempting to treat infections of mucous membranes by local applications.

It seemed certain that in the case of suppurating joints a difficulty of a similar nature, and much more marked in degree, would be encountered, and that it would be foolish to expect a dye injected into a joint cavity filled with pus and fibrin to reach the depths of a mucous membrane which is covered with the same material intimately attached to it.



FIG 15 —Aspirating needle used (actual size, bore of needle—inside measurement—4 mm )

Before applying the dye to the surface of the joint it was, therefore, necessary to devise some method of efficient preliminary cleansing of that surface. For this purpose the apparatus illustrated in Fig 16 was devised. It consists essentially of a number of chambers, connecting with each other by means of tubes controlled by stopcocks, and the whole system leading on the one hand to a single tube to be connected with the needle inserted into the joint (*a*), and on the other, to a reversible, rotary electric pump (*b*). This apparatus, with the aspirating needle (see Fig 15) attached, can be autoclaved ready for use, the bottles containing any fluids desired for irrigation or therapeutic purposes. After the aspirating needle has been inserted into the joint, the whole system is a closed one with no possible risk of contamination. The joint may then be irrigated as long as desired without exposing any of the interior of the apparatus, so that the usual dangers to a joint, of contamination from without, present in any method of aspiration and irrigation dependent on syringes or gravity, are avoided. The aspiration and irrigation may be readily done under local anæsthesia and may, therefore, be repeatedly done.

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A description of the technic developed (the clinical studies thus far have been concerned only with the knee-joint) will best illustrate how the apparatus is used. About 150 cc of 2 per cent novocaine are placed in bottle A (Fig 16), reservoir C is filled with salt solution, reservoir D with gentian violet, and the apparatus is autoclaved and allowed to cool. A large calibre aspirating needle (see Fig 15) is attached to the rubber tube at F and a rubber tube leading from G attached to the outlet of a reversible, rotary electric pump. H and I are air traps to prevent the suction of fluid from A and B back into the

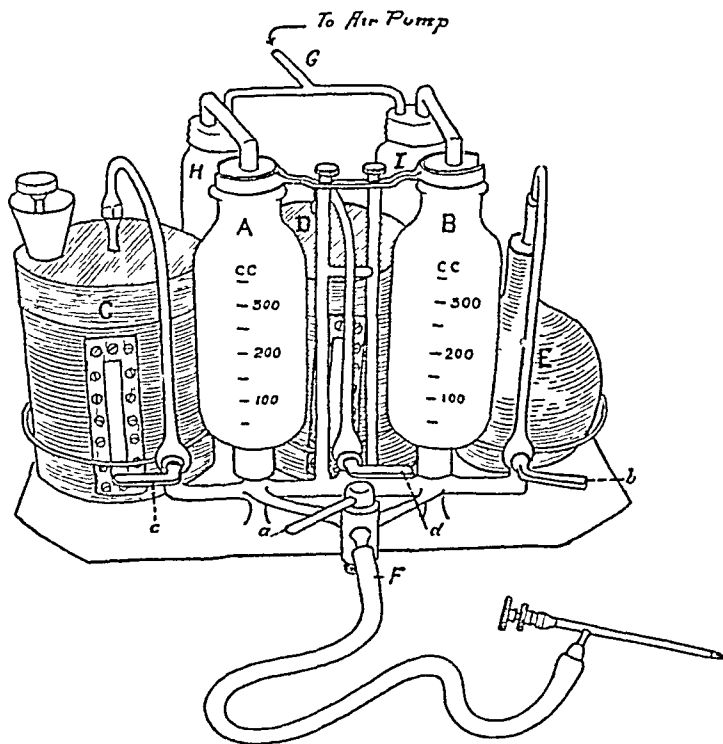


FIG 16 —Diagram of irrigating apparatus made from photograph. The air pump used is a reversible rotary electric pump giving a maximum pressure of 130 mm of mercury and a maximum vacuum of 160 mm.

pump. It will be apparent that by opening the proper stopcocks and using either suction or force in the pump, it is now possible to apply this suction or force to the joint or to any one of the bottles in the system, and thus either to distend or to empty the joint as well as to fill or to empty the bottles at will. For example, after the usual skin preparation of the knee and careful isolation of the field with towels, a small area of skin and subcutaneous tissue is infiltrated with 2 per cent novocaine. The aspirating needle is then inserted into the joint, the skin being dislocated over the subcutaneous tissue in the usual way to prevent subsequent fistula formation. The obturator is now pulled out

of the needle, suction started in the pump, and the cock *a* opened. Any fluid in the joint is thus aspirated into bottle B. By closing *a*, opening *b*, and applying force in the pump, this fluid is then forced into bottle E to be preserved for examination. Stopcock *b* is now closed, stopcock *a* reversed, and force started in the pump. Novocaine is thus forced out of bottle A into the joint, which it distends. The novocaine is left in the joint for five minutes and then aspirated into bottle B until the joint is quite empty. Salt solution is then drawn from reservoir C into bottle A, forced from bottle A into the joint and withdrawn from the joint into bottle B, from which any excess can always be easily forced into bottle E. In this way the joint can be effectively irrigated as often as one pleases. After thorough irrigation in this fashion the gentian violet is forced from reservoir D into bottle A (by opening stopcock *d*), and thence into the joint, where it is left as long as desired, to be again aspirated into bottle B. It is thus possible to anæsthetize a joint, irrigate it repeatedly and effectively, and apply therapeutic agents to every nook and cranny of the cavity by means of an apparatus which remains closed from start to finish of the operation\*.

I have treated by this method of repeated joint irrigation followed by staining of the synovial membranes with gentian violet a small number of streptococcus and gonorrhœal joints.

Thus far I have been chiefly concerned with the development of a technic, and by means of the apparatus described have found that repeated joint irrigations may be readily carried out under local anæsthesia. I have been quite struck with the fact that the first distention of the joint, before anæsthesia can be regarded as established, causes no pain or discomfort whatsoever. The strength of gentian violet used for this purpose has been one to one thousand. This dilution was of course worked up to with great caution, the experiments in the human being being constantly preceded by experiments in animals to indicate what dilutions could safely be used. It was found that gentian violet in this strength caused no pain or signs of subsequent irritation. In some cases the dye was used in a strength of one to five hundred.

As to the results of this method of treatment of joint infections with gentian violet, it is at this time too early to speak positively. The purpose of this paper is to describe an effective method of joint lavage. This had to be developed before attempts to apply the bactericidal prop-

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\* Since this article was written the apparatus here described has been modified so as to make it above criticism from a bacteriological stand-point. No air reaches the interior of any part of the new apparatus except through a bacteria-proof filter. This will be described in a subsequent publication.

## TREATMENT OF JOINT INFECTIONS

erties of gentian violet, first observed two years ago, to infectious processes in the joints, could be logically undertaken. And the method I have outlined has gone a great way toward the solution of the preliminary problem. The number of cases treated is small, but some of them have put the method of lavage and staining to a rather severe test. It can be said at least that the results have been sufficiently encouraging to justify a continuance of the study, which is now being carried on in the laboratory of surgery at Yale University and in the wards of the New Haven Hospital.

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## ACUTE GANGRENE OF THE GALL-BLADDER FOLLOWING INJURY

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ACUTE gangrenous inflammation of the gall-bladder associated with stone is not an uncommon condition. It is only in the absence of stone that these cases assume unusual interest. One or more of three underlying conditions are essential to gangrene of the gall-bladder, one, distention, two, interference with circulation, and, three, infection. The presence of a large stone in the cystic duct may in itself act in these three ways.

As Czerny<sup>1</sup> has pointed out, a large stone locked in the cystic duct may cause not only distention, but by direct pressure on the cystic artery may sufficiently interfere with circulation to cause gangrene.

Friedrich<sup>2</sup> asserts that the majority of cases of gall-bladder gangrene are associated with solitary stone either locked in the cystic duct or in a contracted gall-bladder. The pressure of the stone causes a decubitus ulcer which is frequently the site of a gangrenous perforation. Here the gall-stone plays the same rôle as a fecal stone in the far more frequent gangrenous appendicitis.

According to Aschoff, a gall-bladder which has been the seat of infection is at all times liable to be the site of severe recurrent inflammation. In apparently healed gall-bladders he has demonstrated streptococci dormant in the deeper layers of the mucosa. These germs may be lighted to renewed activity by slight trauma. These cases are analogous to the severe appendix inflammations, which so often occur after repeated mild attacks.

The explanation of acute gangrene of the gall-bladder unassociated with stone is always difficult. Kocher<sup>3</sup> reports a case of acute gangrene of the gall-bladder occurring on the eighth day of an otherwise uneventful course and following an operation for ventral hernia. The patient suddenly experienced a violent attack of pain in the right hypochondrium with chills and high fever. Operation revealed a gangrenous gall-bladder distended to the size of a small pear.

One of the most interesting cases of gangrene of the gall-bladder, without stone, is reported by Korte<sup>4</sup>.

A woman, twenty-one years old, three months pregnant, became suddenly ill, with intense pain in the epigastrium, followed by chills and fever, and the development of exquisite tenderness in the right hypochondrium. Operation on

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the twelfth day of the illness revealed a perforating gangrene of the gall-bladder, without stones Korte says of this case, that it must be supposed that following an acute infection, the opening of the cystic duct became occluded This, of course, was followed by a distention, infection and gangrene

Brunning's<sup>5</sup> case is in many ways similar to Korte's While riding on an electric car a man sixty-eight years old experienced a violent pain in the hypochondrium, associated with collapse This was followed by a continued prostration, chills and fever Operation on the eighth day revealed a complete gangrenous gall-bladder with hemorrhagic infiltration of the mucosa

This case Brunning also attributes to an acute virulent infection with inflammatory closure of the cystic duct

Ransohoff's<sup>6</sup> case is in a way similar to Kocher's A previously healthy male, aged twenty-one, after unusual indulgence in beer, had a violent attack of vomiting This was almost immediately followed by excruciating pain in the epigastrium and lower abdomen and septic prostration The diagnosis was made of acute gangrenous appendicitis, but the operation revealed a gangrene of the gall-bladder

The S-shaped course of the cystic duct seems to have a peculiar effect on these cases As the distention of the gall-bladder increases, the angulation of the S-shaped curve of the cystic duct becomes more acute, making the obstruction more complete The more complete the distention, the more complete the obstruction, and *vice versa*

In many of these cases it seems not unlikely, particularly in the cases of Ransohoff and Kocher, that the obstruction was primary, and the infection secondary In both cases it is not improbable that the vomiting may have caused an angulation of the cystic duct with complete obstruction, followed by acute over-distention of the gall-bladder infection and gangrene from interference with the circulation The intimate relation of the cystic artery with the cystic duct presupposes that an acute angulation of the duct might be accompanied by obstruction of the artery An analogy of this type of gangrene is occasionally seen in an otherwise normal ovary with twisted pedicle

CASE—M L, male, aged forty-five, Portsmouth, Ohio Six years ago a gall-bladder operation was performed by Dr J B Deaver, of Philadelphia As the history of this operation was not available, it was not known whether a cholecystectomy or a cholecystostomy had been done Two weeks before the onset of the present illness the patient had fallen from a step-ladder, receiving a severe blow in the region of the "floating rib" on the right side The soreness disappeared after several days May 1, without previous warning, he had an attack of excruciating pain over the gall-bladder region, accompanied by vomiting and prostration This was followed by fever ranging from 101° to 104°,



with rapid pulse and chills May 4, I saw the case with Dr S S Halderman, at Portsmouth The patient presents every appearance of being seriously ill

The facial expression is that of peritonitis, and the body is covered with cold perspiration Although there is no jaundice, the patient has that subicteric hue, so characteristic of severe infections about the liver Temperature  $101^{\circ}$ , pulse 130, leucocyte count, 18,000 There is exquisite tenderness over the gall-bladder region, the most superficial pressure eliciting excruciating pain

There is a scar, evidently of an old gall-bladder incision, over the hypochondrium Considering the history, the exquisite pain and tenderness, and the evident serious sepsis, the diagnosis of acute gangrene of the gall-bladder was made

Under ether anæsthesia, an incision was made through the middle of right rectus, and the gall-bladder was found buried in adhesions It was distended to the size of a pear, completely gangrenous, but not ruptured The gall-bladder was opened, and a large quantity of black bile and pus, mixed with shreds of gangrenous mucosa, was evacuated Almost the entire mucous coat of the gall-bladder came out in pieces As the condition of the patient was far too grave to consider cholecystectomy the operation was completed by inserting a drain in the gall-bladder, and protecting the entire region by packing The recovery was slow but uncomplicated The fistula closed in about eight weeks Since then the patient has been free from all symptoms

It is an interesting fact that in many of these very severe infections of the gall-bladder the pre-operative diagnosis of acute gangrenous appendicitis is made In this case, of course, the diagnosis was simplified by the previous history The diagnosis is particularly difficult in those cases which give absolutely no history of previous gall-bladder trouble, but come on without warning of any kind It is noteworthy that in the presence of severe intra-abdominal infections the entire abdominal wall is often so rigid as to preclude an exact localization of the lesion This is occasionally seen in acute perforation of a duodenal or gastric ulcer, without previous symptoms However, it is unwise in any of these cases to wait for localizing symptoms to develop Desirable as exact diagnosis is, under all conditions, it is nevertheless advisable to operate in these cases even in the absence of exact diagnosis, as any delay is apt to take away the patient's only possible chance of recovery The evidence of intra-abdominal disaster is sufficient indication for operation

The cause of the gangrene of the gall-bladder in the case cited

## ACUTE GANGRENE OF THE GALL-BLADDER

above is not easy to ascertain. The trauma experienced two weeks before was in all probability a causative factor. This may have acted by liberating bacteria dormant in the deeper layers of the mucosa. Another possibility is that of a twist of the adherent gall-bladder, with subsequent distention and infection.

The grave condition of these cases as a rule prevents cholecystectomy. Fortunately it is unnecessary, as the gall-bladder mucosa usually sloughs out, often as a whole, during convalescence.

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## SITUS VISCERUM INVERSUS WITH GALL-STONES

By HARRY W HORN, M D

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THE very interesting condition of situs viscerum transversus is rare, and the occurrence of gall-stones when this condition is present is evidently of much greater rarity, judging from the literature. The symptom complex may be extremely perplexing and, unless a complete physical examination is made, the possibility of the occurrence of a left-sided cholelithiasis may be lost sight of.

The occurrence of pain in the left hypochondrium, with tenderness underneath the left costal arch, or epigastric pain with radiation to the left hypochondrium, accompanied by left hypochondriac tenderness may be cleared up by a careful examination of the chest. The cases reported have all shown a coexisting cardiac transposition, and, in those cases in which a diagnosis was made before operation, the finding of the dextroposition of the heart was the key-note to the solution of the diagnosis. The X-ray will verify the condition. The cases have usually gone for a number of years without diagnosis.

Bland Sutton, in speaking of abnormalities of the gall-bladder, says the chief of these are connected with complete transposition of viscera. In this connection, the liver lies mainly in the left hypochondrium and the actual condition of its lobes is reversed, the left lobe being larger than the right and lodges the gall-bladder, the duodenum and the stomach are also reversed.

The case which I shall report was referred to me by Dr J Z Hoffman.

The patient, a housewife of fifty-one years of age, presented herself for relief from pain in the left hypochondrium. One year ago she sustained a jarring injury to the left hypochondriac region and since that time the pain has been worse. The pain has existed over a period of thirty years. It is constant and of a severe, aching type, with occasional acute sharp pain. It begins just underneath the left costal arch and radiates upward toward the left shoulder blade and downward over the left half of the abdomen. Often it is cramp-like and has been so severe at times as to demand morphine for relief. Nausea frequently accompanies the pain and a

## VISCERUM INVERSUS WITH GALL-STONES

few times she has vomited. Jaundice has never occurred, and the patient has never observed clay-colored stools. This pain does not bear any relation to the digestive process.

Epigastric distress in the form of a sensation of weight and "heartburn" is of frequent occurrence after meals, with belching of gas. This usually occurs immediately after eating. Bowels are constipated.

Dyspnoea is marked on slight exertion and is associated with severe palpitation. There has been no loss of weight.

*Past History*—There is no history of typhoid. She has had repeated attacks of tonsillitis, with some rheumatism.

*Sexual History*—Menopause occurred four years ago. She has had four full-term pregnancies with no complications. One pregnancy terminated at seven months.

The family history is negative.

Physical examination reveals a woman of small stature and a poorly-developed musculature. There is no jaundice. Palpation over the left hypochondrium reveals pronounced tenderness, aggravated on hooking the fingers under the costal arch on deep inspiration. The epigastrium reveals slight tenderness. The lower margin of the liver can be felt two fingers below the costal arch, on deep inspiration. Examination of the chest reveals the absence on the left side of the cardiac dulness and apex beat. The cardiac dulness begins at the left border of the sternum and extends to the right mamillary line. Heart sounds were heard best on the right. Liver dulness was found on the left side. There is a systolic murmur at the apex. The lower extremities presented slight oedema. (X-ray examination of the chest and abdomen corroborated the diagnosis of transposition of the viscera.)

Blood hæmoglobin 80, red blood-cells 4,200,000, white blood-cells 10,600. Stools, negative. Urine, acid, specific gravity, 1020, trace of albumen, no sugar, a few hyaline casts. Systolic blood-pressure, 130.

• *Operation*—Ether anæsthesia. Assistants, Drs J. Z. Hoffman and Edgerton. A left rectus incision was made. The gall-bladder was readily accessible. Its walls were thickened but free from adhesions. About 70 c.c. of greenish-black bile was aspirated, and the gall-bladder was incised and four mulberry stones, the size of a pea, were removed. The ducts were free. The bladder was drained. The anomaly of transposition of the viscera was verified. The patient did not bear the anæsthesia well and a hasty closure was made. An uneventful recovery followed.

One year later the patient reported complete recovery from

the left hypochondriac distress, but she still complains of epigastric distress

A fairly exhaustive review of the literature reveals the rarity of this condition

CARL BECK reports one case, in which the patient was a woman thirty-nine years of age, who complained of severe headaches followed by vomiting and sometimes chills, pain of a colicky character in the left lumbar region. The attending physician diagnosed transposition of the viscera. When she complained of lumbar pain he found a movable kidney on the left side, and advised nephropexy. This was done and 9 days later the same gastric symptoms recurred. An exploratory incision was then made and cholelithiasis was found, with the liver lying in the left hypochondrium. The patient made a good recovery.

FRANK BILLINGS reports a male aged sixty-four and married. His illness began in 1895. There was history of severe epigastric pain which radiated over the entire abdomen. Great depression without nausea and vomiting. A chill followed by fever occurred and the next day there was slight jaundice. Two more attacks occurred within the next two weeks. In 1896 he visited Carlsbad and other European resorts. Gradually he lost weight. Physical examination revealed the cardiac dulness, beginning at the left sternal border and extending across the sternum to the right nipple line. Heart sounds were heard loudest to the right of the sternum. A hard, tumor-like mass was felt at the costal margin at the tenth left cartilage. Liver dulness was found on the left side and the stomach, distended with gas, occupied the right hypochondriac and epigastric regions. Situs viscerum inversus was recognized and a diagnosis of cholelithiasis was made.

DR CHRISTIAN FENGER operated and found a large stone in the cystic duct. The ducts were all dilated. The anomaly of transposition was verified. The patient died on the fourth day from septic angiocholitis. No autopsy.

H KEHR, LIEBOLD and NEULING report 312 laparotomies for gall-stones, from 1904-1906. Among these cases there was one of complete transposition of the viscera. The patient was fifty-five years of age, and a diagnosis of situs viscerum inversus was made and confirmed by X-ray. The stone was in the common duct. The patient made an uneventful recovery.

WM J and CHAS H MAYO mention the cases reported by Billings and Carl Beck and "one case in our experience." No reference is given to literature containing the report of their (Mayo's) case and the history is not given.

HUPP reports a case of a woman  $4\frac{1}{2}$  months pregnant and suffering from cholelithiasis. She was deeply jaundiced and had been steadily losing weight. Operation was decided upon. Transposition of the viscera was not suspected. A right-sided incision was made and the gall-bladder was not found in the usual location. Further exploration revealed the liver completely transposed to the left side. Two large stones were removed from the cystic duct and the patient made an uneventful recovery and was delivered at full term of a normal child.

BLAND SUTTON states that in 3000 abdominal sections, covering a period of 20 years, he encountered once the condition of transposition of the viscera, but not in conjunction with cholelithiasis.

## VISCERUM INVERSUS WITH GALL-STONES

In the *Transactions of the Berlin Medical Society*, January 25, 1905, KEHR reports in ten years' experience, with 10,000 autopsies, he has found situs viscerum inversus twice

GEIPEL in an exhaustive study, "Ein Beitrag zur Lehre des Situs Transversus," does not add any further cases pertaining to this condition

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# CARCINOMA OF THE SMALL INTESTINE

WITH THE REPORT OF A CASE EACH OF THE JEJUNUM AND OF THE ILEUM

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THAT carcinoma of the small intestine is uncommon is evidenced by the rarity of its appearance at the autopsy table

Nothnagel at the Vienna General Hospital between 1882 and 1893, in 24,358 autopsies, observed 243 cancers of the bowel, and of these but 6 were of the ileum and none of the jejunum

Lubarsch at the Pathological Institute of Breslau between 1878 and 1891 observed 42 cancers of the bowel, 2 in the ileum and none in the jejunum

Fr Muller in the Pathological Institute of Bâle in 11,314 autopsies observed 123 cancers of the bowel, of which 2 were of the ileum and none of the jejunum

Max Muller in the Pathological Institute of Berne between 1866 and 1897 in 5621 autopsies observed 41 cancers of the bowel, 3 in the ileum and jejunum

There are many more pathological statistics which might be cited, but from the foregoing it is sufficiently evident that carcinoma of the small intestine and particularly the jejunum is an uncommon condition

Only 23 cases had been reported up to 1906 but in the last few years the number has risen rapidly, until in a very comprehensive study of the subject, Venot and Parcelier<sup>1</sup> have collected and reported in detail 50 such cases

It is the writer's wish to add to this list the two cases cited below, one a cancer of the jejunum and one a cancer of the ileum

CASE I—Mr C, aged forty-five Towerman Examined January 17, 1914 Referred by Dr R D Elliott Was operated for fistula in ano 4 years ago Otherwise well up to present trouble No liquor or tobacco Has one daughter twenty years old, strong and well Wife has had one miscarriage at the second month of pregnancy Denies syphilis and gonorrhœa

Six months ago stomach began to bother him, causing distress with everything eaten He describes his feeling as distress in the stomach region, coming only after eating or drinking At this

same time he began to complain of loss of strength, particularly weakness in the legs. In a month from this time began to vomit occasionally after eating, and after vomiting discomfort was relieved. Since last August has had an increasing pallor which has kept pace with his loss in weight. Has also had a good deal of difficulty in obtaining a bowel movement, necessitating the frequent taking of castor oil. The vomiting has increased in frequency until now he vomits every two or three days. Best weight, 195 pounds, now weighs 181 $\frac{3}{8}$  pounds. Has never vomited any blood or passed any dark-colored stools. No "heart-burn." Since taking olive oil of late, patient thinks that he has had less discomfort after meals.

Is well-developed and nourished. Cachectic in appearance. Hæmoglobin 70 per cent. Eyes, tongue, neck, lungs, heart and extremities do not present anything unusual or abnormal. Liver apparently not enlarged. Spleen not palpable. Abdominal examination shows considerable tenderness over the area occupied by the splenic flexure or just internal to it. Here there is felt a hard movable mass apparently small but indefinite in outline on account of its depth. The mass ascends and descends little or none with respiration, but is freely movable. Temperature normal. Pulse 84. Urinary examination negative.

A provisional diagnosis of carcinoma of the small intestine was made, and the patient sent to the Deaconess Hospital for operation.

*Operation* (at the Deaconess Hospital January 19, 1914) — Dr. Burton Hamilton etherizing, Dr. H. G. Webb assisting. A left rectus incision was made over the epigastrium. No mass or masses could be felt on the first exploration with the hand, but on a more careful examination a small tumor which consisted of what appeared to be an annular carcinoma, completely surrounding the bowel, was found in the jejunum about 18 inches from the ligament of Treitz. An intestinal lumen just large enough to admit the finger-tip remained unconstricted. About eighteen inches of bowel with its mesentery was resected, and an end-to-end anastomosis done. The making of the anastomosis was somewhat trying, as the upper end of bowel consisted of the stump of the jejunum so close to the retroperitoneal portion that the passage of sutures was rendered difficult. There were a few glands deep in the mesentery, most of which could be resected. The wound was sewed up in layers. Good ether recovery. Pathological report on specimen *adenocarcinoma*.

The convalescence was uneventful save for a stitch abscess, and the patient left the hospital on the twenty-eighth day after the operation.



The patient was last seen a few weeks ago, approximately fourteen months after the operation. He has gained 20 pounds in weight, has a good color, no cachexia, and has been working steadily at his occupation as a tower switchman now for several months.

CASE II—Mrs. C. Four years ago suffered an attack of inflammatory rheumatism. Cough for the last year. Periods ceased at forty-two. For the seven months up to one month ago, bowels have moved 3 to 7 times a day, but for the last month she has been constipated. For the past month has had colicky pains low down on left side of abdomen, and with these attacks of colic the abdomen has become distended. Has vomited but once during the past three months and the vomitus on that occasion was dark brown material, which the nurse thinks might have been blood. Her weight during the past six months has diminished from 128 to 98. There has been no visible blood in the movements. Has been in bed four weeks because of "pain in the abdomen and loss of strength."

She is well-developed and poorly nourished. Despondent. General physical examination negative, except for the abdomen.

Abdomen. Just to the left and slightly above the umbilicus is a freely movable, hard mass, the size of an egg, irregular in outline, and not tender on pressure. This mass may be pushed freely from the left side of the abdomen to the right side, where it does not seem as close to the skin. It also displaces upward and downward freely. Urine examination, negative. Benzidine test for blood in the feces positive after three days on a meat-free diet.

*Operation* (at the New England Baptist Hospital)—Etherizer, Dr. E. N. Libby, assistant, Dr. Harold Webb. Incision just to the left of the median line, extending from below ensiform to umbilicus. A small discrete carcinoma of the small intestine about six feet from the ileocaecal valve found. The growth involved all of the coats of the bowel, and although larger on one side than the other, completely encircled the intestine so that its lumen was almost wholly occluded. There were practically no enlarged glands in the mesentery. An excision of about one and one-half feet of bowel with a wedge-shaped piece of the attached mesentery and an end-to-end anastomosis by suture was made. There was no involvement of the liver or other abdominal organs to be felt. The wound was sutured in layers, and the patient made an uneventful recovery, but died five months later of apparent recurrences in the abdomen. Pathological report on specimen *adenocarcinoma*.



FIG 1 —Photograph of section of intestine removed, showing the ring-like form of the carcinoma



## CARCINOMA OF THE SMALL INTESTINE

Regarding the appearance of this condition more commonly in either sex, it is quite likely that it is no more common in the male than in the female Keyser<sup>2</sup> in a collection of 11 cases found 6 in males and 5 in females Venot and Parcelier, however, found but 30 per cent in females and 70 per cent in males

The average age as given by Keyser was 43.9 years Venot and Parcelier state that it occurred in the series from 3½ years up to 82 years, but that it was a veritable curiosity up to 30 years

In practically all of the cases observed, the tumor has been of more or less annular or ring-like form (see Fig 1), infiltrating all of the layers of the intestinal wall The specimen in Case II, which unfortunately was not photographed, was somewhat larger on one side than the other, but on the whole similar to the above illustration There are, however, cases in which this annular form is not taken One was reported by Curtis<sup>3</sup> in which the mass involved nearly five inches of intestine without obstruction, and another by Keyser in which the intestinal lumen was of the size of a cocoanut

The symptoms of carcinoma of the small intestine must be in the beginning vague and indefinite, and until either some degree of obstruction or a palpable tumor is present, too uncertain upon which to base a diagnosis at once Pain in both of the cases here reported was an early symptom and has been in a majority of the other cases reported The pain in these two cases has been the result of interference with the onward passage of intestinal contents, since in Case I it was spoken of as distress with everything taken, and in Case II as colicky pain attended with distention at the time of the attacks

It is interesting to observe that in Case I the pain or distress was directly relative to eating, while in Case II, in which the growth was in the ileum, the pain was rather of the nature of intestinal colic or obstruction Vomiting in these two cases as well as in many of the other cases reported has been a fairly constant factor, and is dependent upon the degree of obstruction present either temporarily or permanently Constipation in both of these cases has seemed to have been of sufficient importance to cause the patient to remark about it, and has also been prominent in the other cases reported in the literature on the subject Diarrhœa is said to be much less frequent than constipation Loss of weight in the first case was of no remarkable amount, although there was a markedly cachectic appearance with the lemon-like coloring so often observed in pernicious anæmia There was a marked loss of weight in the second case and also in many of the other reported cases The loss of weight while suggestive of

malignancy, apparently does not appear until obstruction occurs, and so, fairly late in the disease

Neither of these cases were submitted to X-ray examination because of the palpable tumor, but in suspected cases all agree that the most valuable early evidence may be obtained by this method of examination. The presence of a freely movable tumor as occurred in both of these cases should be suggestive of tumor of the small intestine, because tumors here, provided there are no adhesions, move more freely than those of the large intestine on account of the long mesentery of the small intestine. Examination of the stools for occult blood was made in Case II and found positive. All writers agree as to the value of a positive finding in this connection. The decision in these cases as to the choice of operative procedure should not be difficult, and should be as follows: resection where the tumor is free, lateral anastomosis where too firmly bound down by extensive or dense adhesions for resection, and enterostomy in those cases of acute obstruction operated upon as emergencies.

*Prognosis*—It is said by Venot and Parcelier that the prognosis in carcinoma of the small intestine should be less favorable than in carcinoma of the large intestine, yet it would seem in the two cases reported by the writer that the growth of the tumor had been extremely slow, one case having a history suggestive of the growth for six months and the other for eight months. In both cases, too, it may be noted that one of the chief reasons for seeking surgical attention was the symptoms dependent upon obstruction produced by the growth.

If this is the usual type of carcinoma involving the small intestine, and from a perusal of the original articles in which the cases were reported it appears that it is, it seems to the writer that with an early diagnosis it should be a favorable type of intestinal cancer to operate upon, and that earlier diagnosis in this type of growth can be made by submitting these cases with suspicious intestinal symptoms to earlier X-ray examinations.

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# DILATATION OF THE DUODENUM

AN EXPERIMENTAL STUDY \*

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THE coincidence of dilatation of the duodenum and ileac retention is frequently recognized in X-ray studies on gastro-intestinal cases. At operation a dilated duodenum is often found associated with a constriction or angulation or otherwise contracted caudad ileum. These observations<sup>1</sup> have been frequently made by clinical gastro-enterologists apparently without attempting to explain any dynamic correlationship between the muscular or neuromuscular tone of the duodenum and that of the aboral ileum.

Experimentally the problem has presented itself: is there not some causative interplay between incomplete obstruction of the extreme caudad ileum and dilatation of the duodenum? It is commonly known that constipation, long continued, may terminally present the aspects of cæcal stasis. In laboratory terms it is the author's experience that experimentally produced constipation in dogs is followed by the dilated atonic cæcum. In other words, incomplete obstruction of the caudad colon is associated with dilatation and increased dilatability of the cephalad colon. An analogous association has been observed in the ureter.<sup>2</sup> Is there not some functional interdependence of the muscular states of the two ends of the small intestine?

Ochsner's anatomical studies have revealed a concentration of the circular fibres of the duodenum 2-4 cm aboral to the entrance of the common bile duct. He holds that this "duodenal sphincter" may work in concert with the ileocæcal valve and the pylorus: that an appendicitis stimulates the closure of the ileocæcal valve, giving rise to ileac retention, to closure of the duodenal sphincters, thus favoring duodenal ulcer, to pyloric closure—thus interfering with the normal progress of food.<sup>3</sup> It is significant that in this study, dilatation of the duodenum has been found invariably greatest in the portion cephalad of the common bile duct.

Mr Lane,<sup>4</sup> on the other hand, explains duodenal dilatation on a mechanical basis, thus, "The accumulation of material in a large pro-

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lapsed cæcum" may result in ileac delay and accumulation. Or obstruction of the ileum may be still further exaggerated by an "ileal kink" or by a "fixation of the appendix to the under surface of the mesentery by adhesions." "The *accumulation of the material in the small intestine* drags upon and obstructs the duodenojejunal junction. In consequence the duodenum is elongated and dilated and especially in its first portion where it is free and surrounded by peritoneum." Both authors therefore agree in the importance of ileac retention as a factor in duodenal dilatation, but differ in the mechanism of retention, the former mentioning reflex closure of the ileocæcal valve from appendical irritation, the latter holding to mechanical interference with the lumen of terminal ileum.

Bloodgood<sup>5</sup> differs from the preceding authors in applying mechanical pressure at the point of dilatation. This is described under the capita (1) Acute gastromesenteric ileus, (2) chronic gastromesenteric ileus, and (3) filling of the duodenal stump after gastro-enterostomy. With this contention Draper,<sup>6</sup> speaking from the stand-point of the Surgical Laboratory at that time, agreed, declaring that "dilatation does not occur in any organ except at the point of obstruction." The dilatation of the first and second portions of the duodenum were believed due to obstruction of the third portion. That the mesentery may exert such pressure has been doubted by Lynch<sup>7</sup> and others. That the pressure presumably exerted may affect an immediate dilatation depends upon the amount of pressure. The obstruction if incomplete must be greater than the potential peristalsis of the duodenum, as appears from experiments on the caudad ileum. Apropos of this dilatating load, Keilty and Smith,<sup>8</sup> in their recent review of 100 human autopsies, express themselves as follows. Stasis "is brought about by rapid reduction of the lumen of the gut without establishment of compensation or with compensation but with increased load producing fatigue and dilatation." Filling of the duodenal stump has been repeatedly observed experimentally. Occasionally this filling may be due to the relation of the oral duodenal loop to the stomach wave.

Dog 224, mongrel, female. Small intestine divided at caudad end of the oral third. Caudad two-thirds were anastomosed at mid-point, with antrum pylori placing stoma parallel with the greater curvature. Five days later greater amount of stomach test-meal that had passed through stoma traced into oral segment, opening into distal segment patent.

Dog 232, mongrel, male. Small intestine divided at same point. Caudad segment 5 cm aborally anastomosed laterally in same manner to antrum pylori. A" test substances that passed through the pyloric stoma found in duodenal stump, opening into distal segment patent.<sup>9</sup>

## DILATATION OF THE DUODENUM

Should the passage into the jejunal segment be occluded certainly the contents of the duodenal segment must be so much the more increased. Hence it appears a pathologic load applied directly to the duodenum by a tensely drawn mesentery or the over-filling of the duodenal stump following gastro-enterostomy by the peristaltic stomach wave may dilate the proximal duodenum.

Christian<sup>10</sup> quoted Ochsner and Bloodgood and assumed duodenal atrophy to be associated in some way with gastric atony and pyloric relaxation.

It is generally agreed that mechanical obstruction [understood to be qualified as above described, this virtually amounts to a complete physiological obstruction] of the duodenum may give rise to immediate duodenal dilatation and that incomplete mechanical obstruction of the extreme caudad ileum from adhesions incident to appendicitis or surgical stasis is *occasionally coexistent with* mediate dilatation of the duodenum.

A number of animal experiments have been performed to determine a possible causative relationship of incomplete caudad ileac obstruction to dilatation of the duodenum. The ileum, 3 cm from the ileocolic junction, was loosely ligated with gauze, so that the resultant potential lumen of the ileum within the gauze was equal to the lumen of the relaxed ileum. In a few of the animals a segment of ileum 8-10 cm cephalad of the ligature was demarcated by a linen suture run through the seromuscular wall and loosely tied. A duodenal segment of equal length in every dog was defined by a similar suture an equal distance caudad of the pylorus. In order to decide definitely on the presence or absence of dilatation in all the latter dogs, each loop was injected with water from a 2 c c syringe, with intermuscular needle, until the injecta reappeared at the detached end of the needle on disconnecting the syringe. The ends of the outlined loops were compressed digitally during the filling of the segments. The amount of injected fluid was taken as a measure of the potential size or dilatability of each intestinal segment at the time of distention.

Dog No 19, bull, male October 29, 1914 Ileum compressed by gauze strip, 2 cm in width, sutured end-to-end and, snugly, about walls of ileum 2 cm from ileocolic junction.

November 5, 1914 Dilatation of duodenum for cephalad 12 cm.

Dog No 112, mongrel, male December 3, 1914 Caudal ileum compressed by gauze in similar manner.

December 9, 1914 Was operated upon for other reasons, and duodenum was noted dilated.

Dog No 131, mongrel, female December 10 1914 Terminal ileum incom-



pletely resected for 2 cm and reconstructed with a diameter of one-half original size

January 17, 1915 Marked dilatation of duodenum

Dog No 149, mongrel, male February 4, 1915 Caudad ileum ligated by moistened gauze strip so that resulting lumen measured approximately 1 cm in diameter Duodenum defined 10 cm caudad by a linen seromuscular suture Dilatability 14 cc

February 9, 1915 Duodenum dilated Dilatability 19 cc Stomach contracted, colon dilated

February 13, 1915 Duodenum dilated for 15 cm caudad of pylorus Dilatability 24 cc

Dog 179, mongrel, male February 4, 1915 Caudad ileum obstructed incompletely by gauze band Duodenum defined at arbitrary caudad plane by linen suture Duodenum dilated Stomach small Dilatability 10 cc.

February 9, 1915 Duodenal dilatability 22 cc

February 16, 1915 Duodenum buried in adhesions, freed, and admitted but 9 cc Adhesions undoubtedly interfered with further dilatability

Dog No 223, mongrel, female March 9, 1915 Caudad ileum ligated with gauze strip, 8 cm cephalad of ligature defining suture of linen inserted An equal segment of duodenum similarly defined Dilatability of ileal segment 10 cc, duodenal segment 14 cc

March 18, 1915 Ileum cephalad of gauze ligature impacted with faeces for 10 cm, which converted the incomplete into a complete ileac obstruction Under this condition dilatability of duodenum was 6 cc and of ileum 60 cc

Dog No 251, mongrel, male March 27, 1915 Extreme caudad ileum ligated with gauze, without encroaching upon lumen of gut as found in relaxed state Duodenal and ileac segments defined as above Dilatability of duodenal segment 9 cc and of ileac 6 cc

April 1, 1915 Ileac loop contained small amount of pasty fecal material cephalad of ligature This was emptied before injection The apparent dilatation of either loop was negligible Dilatability of duodenal segment 10 cc, of ileum 8 cc

Dog No 252, mongrel, male March 27, 1915 Similarly treated Animal had mucopurulent nasal discharge and tonicity of intestine appeared very low Ileum ruptured longitudinally while being injected Died 36 hours later of pneumonia Dilatability of duodenum on March 27 14 cc, of ileum 12 cc At autopsy duodenum showed no change

Dog No 259, mongrel, male April 1, 1915 Similarly treated Dilatability of duodenum 14 cc, of ileum 8 cc (loops of unequal lengths)

April 6, 1915 Duodenum dilated by inspection, dilatability 20 cc.

Ileum enveloped in adhesions not dilated and ruptured when injected to capacity of 14 cc Gauze removed

April 8, 1915 Duodenum appeared more dilated, but held 12 cc only Ileum showed productive inflammatory change, held 3 cc

Dog No 260, mongrel, female April 1, 1915 Used as control No obstruction but loops demarcated and injected

Duodenal dilatability 10 cc, ileac dilatability 8 cc.

Marked contraction of distended ileac segment followed immediately upon

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release of distention. A contractile wave appeared subsequently in cæcum and cephalad colon.

April 6, 1915. Ileocolic intussusception found and released. Under these conditions duodenum was noted not dilated and capacity found to be as above, 10 c.c. *Completely obstructing ligature placed about ileum cephalad of injured portion.*

April 8, 1915. Duodenum *apparently* dilated greatest at region of common bile duct entrance and traceable to 2 cm. caudad. Dilatability only 4 c.c. Ileum seriously damaged and impacted for 10 cm. cephalad to ligature.

Dog No. 264, fox terrier, male. April 6, 1914. Incompletely obstructed at terminal ileum 2 cm. cephalad of ileocolic junction. Dilatability of duodenum 10 c.c., of ileum 10 c.c.

April 13, 1915. Adhesions about defining sutures. Ileum kinked by omental adhesions. Duodenum *contracted*, capacity 4 c.c. Ileum unchanged.

Dog No. 265. April 6, 1915. Control treated in the same manner with the omission of obstructing ileac ligature. Dilatability of duodenum 18 c.c., of ileum 8 c.c.

April 13, 1915. Duodenum and ileum grossly unchanged. Dilatability of duodenum 10 c.c., of ileum 6 c.c. *Completely obstructing ligature placed about caudad ileum.*

April 15, 1915. Duodenum *contracted*. Dilatability 6 c.c.

To determine a possible causative relation of cæcal stasis to dilatation of the duodenum as suggested by Lane, the following experiment was performed.

Dog No. 266, mongrel, male. April 8, 1915. Colon 2 cm. caudad of ileocolic junction ligated loosely, leaving potential lumen 1 cm. Duodenal segment defined and found dilatable to 14 c.c., cæcum dilatable to 12 c.c.

April 13, 1915. Duodenum unchanged, held 12 c.c. Cæcum not grossly changed, held 8 c.c. *Completely obstructing ligature placed about terminal ileum.*

April 15, 1915. Duodenum *contracted*, held 6 c.c. Colon distended with gas and dried faeces.

To determine the possible causative dilatation of duodenum by appendicitis, the following experiment was performed.

Dog No. 267. April 8, 1915. The cæcum of the dog, similar in many respects to the occasional funnel-shaped human cæco-appendix, was injected with an emulsion of another dog's faeces and firmly ligated 5 cm. cephalad of tip. Duodenal loop defined and injected to 14 c.c.

April 13, 1915. Ruptured gangrenous cæcum and diffuse purulent peritonitis. Stomach unchanged. Duodenum unchanged, dilatability 8 c.c. Caudad ileum unobstructed.

Under the conditions of the foregoing experiments the following observations therefore have been made:

(1) Incomplete obstruction of the extreme caudad ileum gives rise to dilatation and increased dilatability of the cephalad duodenum.

(2) Complete obstruction of the extreme caudad ileum gives rise to no apparent change and decreased dilatability (or perhaps increased tonicity) of the cephalad duodenum.

(3) Incomplete obstruction of the cephalad colon or purulent typhlitis gives rise to no apparent change and decreased dilatability of the cephalad duodenum

The researches of Alvarez,<sup>11</sup> Gerlach,<sup>12</sup> and Biedermann<sup>13</sup> have contributed certain important data bearing upon the relations of the duodenum with the caudad ileum. Alvarez made the following significant observation from his studies on intestinal segments of rabbits: "In removing the segments it was found best to begin at the

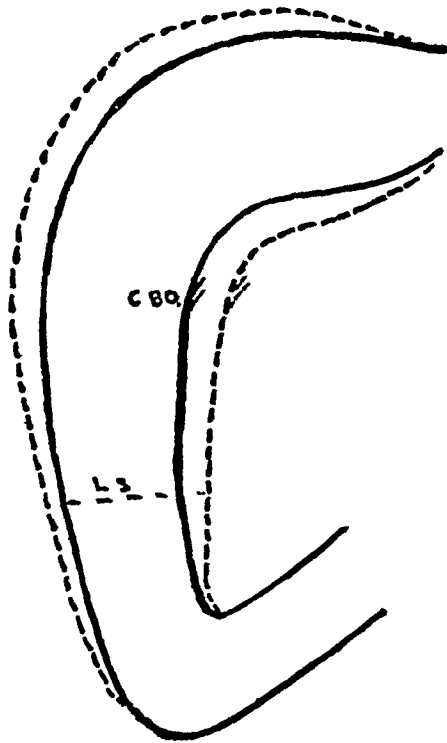


FIG 1.—Diagram representing normal duodenum in full and dilated duodenum in broken, line. In experiments presented the duodenum of mean volume of 12.2 c.c. dilates to a mean volume of 19.2 c.c. in 5.8 days following a fixed potential diameter of caudad ileum of approximately 1 cm. (or incomplete obstruction). C B D, common bile duct, L S, limiting suture.

pylorus and to proceed downward, as the bowels soon became distended and atonic after ligation of the ileum. When this happened segments from the duodenum did not beat well—the amplitude was poor, the rhythm was irregular, and fatigue appeared early." Gerlach has found considerable variation in the thickness of Auerbach's plexus in different parts of the intestinal tract. In the first 5–6 cm of the duodenum he observed the largest fibres intermingled with the greatest number of ganglion cells. Below this point, which possibly corresponds with the site of Ochsner's "duodenal sphincter," the fibres gradually lost their

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cells and the meshwork became wider. Upon this nerve-net, according to Biedermann,<sup>15</sup> depend the rhythm and size of the peristaltic waves.

The whole neuromuscular arrangement appears quite analogous to that described for the ureter by Bardeleben,<sup>14</sup> and no doubt furnishes adequate anatomical explanation for the analogous physiological mechanisms of the small intestine and the ureter.

It is extremely difficult and hazardous to correlate all this experimental and anatomical material. It is evident, however, that an incom-

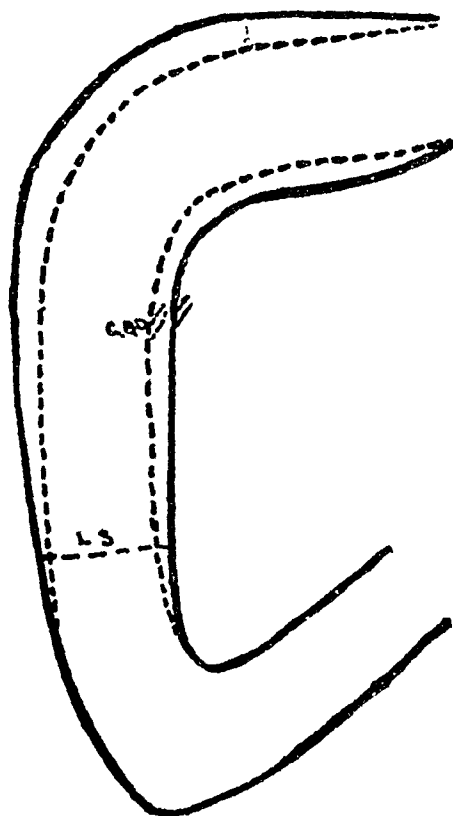


FIG. 2.—Diagram representing normal duodenum in full, and contracted duodenum in broken line. In experiments presented, duodenum of mean volume of 14 c.c. contracts to a mean volume of 6.25 c.c. in 5 days following a fixed potential diameter of caudad ileum of 0 (or complete) obstruction. C B D, common bile duct, L S, limiting suture.

plete obstruction permits the free intercommunication of the duodenal and caecal centres through Auerbach's plexus, whereas a complete obstruction interferes with such relationship. Furthermore abnormal caecal stimuli, whether from an inflammatory appendix or an incompletely obstructed caecum, may have the same cumulative effect upon a duodenal centre as does the abolition of all such stimuli together. In other words, we should expect in the first case (incomplete ileac obstruction) a duodenum laboring to the points of fatigue and dilatation under

a plus physiologic load, and in the latter case (complete ileac obstruction, incomplete cæcal obstruction, and typhlitis) a conservation of duodenal contractile power and a more tonic duodenum

The author is indebted to Prof G S Huntington for his constructive criticism of this paper

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# CONTRIBUTION TO THE SURGICAL PHYSIOLOGY OF THE COLON\*

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THERE are three modes of approaching the study of functional abnormalities in the human colon. The first is based upon the influence of heredity and environment, and may therefore be looked upon as biologic in character. The second is based upon facts gleaned through experiments upon the lower vertebrates, through the help of which a good deal may be learned regarding the surgical physiology of the part, and these studies may properly be supplemented by biochemical observations upon human beings in whom the path of the ingesta has been shortened, as, for example, by ileostomy. The third source of information is to be had by a critical clinical interpretation of the subjective and objective changes in human beings observed before and after therapeutics.

It seems clear to the essayists that our knowledge of the colon at this early day is not far enough advanced to justify any exclusive claim for the furtherance of this or that special form of therapy, be it so-called medical or so-called surgical. They therefore present herewith certain data, gleaned as outlined above, in the hope that it may be of use to others as a basis for inductive study, and in the conviction that time and a wider acceptance of the fundamental sciences will soon bridge the rapidly narrowing channel which unfortunately still separates the therapeutics of the physician from that of the surgeon.

Man alone among the mammals possesses the highest intelligence and the most unstable digestion. There are two important phylogenetic reasons for this, and these are often supplemented by errors in ontogenetic development. Until birth he is the variable product of two forces: those hereditary tendencies resident in the germinal material itself, lasting throughout his life, and those imposed upon him by

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the peculiar conditions of his environment during the period of gestation and continuing more or less until death

Phylogeny ordains that man shall often bear a heavy, segmented colon, semi-herbivorous in type, and that he shall walk upright. The herbivorous colon is obviously designed to be supported by the anterior parietes, man's habits of life deny this support and subject the badly and imperfectly suspended organ to the pull of gravity for at least half of his life. Shaler<sup>1</sup> considers that the upright position has been paramount among all other factors in fixing the length of the life of man.

Ontogeny furnishes many opportunities for faulty growth and position. On account of the very complex human development, during which the individual foetus must follow a narrow and devious path of extreme antiquity, there are innumerable opportunities for arrested or irregular form.

Man, in other words, while following his long and complex course of development, is swayed by two differing forces, heredity and environment. An appreciation, therefore, that even in his alimentary canal he is the product of these complex forces must be helpful in understanding the maze of adult variations of form, position, and function, which confront the student of gastro-enterology. Our course of reasoning must be changed from the deductive to the inductive form of thought. Deficiencies in type must be recognized by the diagnostician early in life if therapy is to hope to make amends for nature's shortcomings in any given individual. In the purest type you can collect, there are hundreds of species.

Wiedersheim has collected one hundred and eighty variants of the hereditary type in human beings. The persistence of the lanugo as seen in the Russian dog men, or of the palmar muscle which enables babies to support themselves from a rod and grown men to bend small coins, and which normally disappears, are excellent examples of the tenacity of early characteristics. How logical it is, therefore, to trace many of the colonic variations which we know invite disease to the persistence of embryonic conditions which may be much less remote in the evolutionary scale, and, because of modern facilities such as the X-ray, just as easily demonstrated. The old-fashioned notion as to inheritance of heart and kidney disease, discredited on the ground of non-transmissibility of acquired conditions, may really be due consideration if it be true, for example, that colonic toxæmia is a factor in the causation of sclerosis. Evidently, in these days of preventive

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<sup>1</sup> Shaler Individual

medicine when the pressure in the social fabric is so acute, and when, just because of our rapid evolution, a very highly developed individual may mate with one of lowly heredity, it must become an engrossing task to find therapeutic methods wherewith to meet and offset the products of disregard of the laws of eugenics. Many a poor, ill-conditioned, clammy-handed child, backward in its studies, seemingly lazy, inefficient, and ill-tempered, is, in light of recent knowledge, not intrinsically delinquent or even intellectually deficient, but often the unhappy result of a congenital dysmorphia of the stomach or cæco-colon. Such defects may be, as stated, due to the inheritance of characteristics unsuited to the human type.

Comparative anatomy<sup>2</sup> of the vertebrates supports the hypothesis of developmental relationship between cæcum and stomach. For example, in the horse, the cæcum and cæcal colon are well developed and complex, the stomach being simple, on the other hand, in ruminants, as the cow, the stomach is complex while the cæcum is simple.

In carnivora the cæcum is naturally small and rudimentary, while in man, who leans to the side of the carnivora, the cæcum probably is of little use and is normally small. Nature has made no provision for an over- or ill-developed cæcum in man, the stomach having taken its place. However, the cæcum not infrequently takes on the herbivorous type. This has all the disadvantages and lacks the delicately adjusted mechanism and advantages of the true herbivorous form. Clearly then this cæcum, from the stand-point of development and usefulness, becomes not alone useless to the human economy, but actually detrimental to it. Such a condition is not to be wondered at when one considers that very divergent developmental paths have been taken by the individual and by its aberrant organ. Bryant<sup>3</sup> has put the classification of human beings into herbivorous and carnivorous upon a firm basis. Furthermore, normally limited in circulation, when the cæcum is over-developed, the blood supply is extremely deficient and weak. As its motility is impaired and its morphology perverted, its current slows and it begins to harbor and to disseminate the unidentified but definitely proven toxic substances which result, indirectly, in disease.

The weak point in the small gut is the duodenum, for its support is deficient. Dilatation often occurs here and may be in turn transmitted to the stomach. Barber's<sup>4</sup> studies show the relation of the

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<sup>2</sup> Keith Human Embryology and Morphology

<sup>3</sup> Bryant The Carnivorous and Herbivorous Types in Man, Boston Med and Surg Jour, March 4, 1915

<sup>4</sup> Barber Dilatation of Duodenum, ANNALS OF SURGERY, October, 1915, p 433



autonomic system to dilatation and are not in direct accord with the views of those who consider the mechanical factor of support, or traction upon the mesentery as paramount. He has demonstrated by a series of animal experiments the different effects upon any tube in the body of partial or complete obstruction. Briefly, partial obstruction of the ileum results in duodenal dilatation, whereas complete obstruction is followed by duodenal contraction and ileac dilatation at the point of obstruction. He has also shown that a close correlation exists between the ileocaecal and the uretero-vesical valves as regards their importance to the economy. His conclusions, shortly to appear in the ANNALS OF SURGERY, are as follows:

"The whole muscular arrangement appears quite analogous to that described for the ureter by Bardeleben, and undoubtedly furnishes adequate anatomical explanations for the analogous physiological mechanism for the small intestine and the ureter.

"It is extremely difficult and hazardous to correlate all this experimental and anatomical material. It is evident, however, that an incomplete obstruction permits the free intercommunication of the duodenal and caecal centres through Auerbach's plexus, whereas, a complete obstruction interferes with such relationship. Furthermore, abnormal caecal stimuli, whether from an inflamed appendix or an incompletely obstructed caecum, may have the same cumulative effect upon a duodenal centre as does the obliteration of all such stimuli together. In other words, we should expect in the first case (incomplete ileac obstruction) a duodenum laboring to the point of fatigue and dilatation under a plus physiologic load, and in the latter case (complete ileac obstruction, incomplete caecal obstruction, and typhilitis) the conservation of duodenal contractile power and a more tonic duodenum."

Turning to the development of the individual colon we find certain critical periods which may be classified as follows. The first coincides with the appearance of the buds from the vitelline duct, from which are developed the hind- and fore-gut. The second is at about the third month when, normally, the bowel rotates. The third is the period of adhesion or fusion, after birth.

*The stomach and caecum have but two important functions, those of storage and motility. All others are negligible.* Because of normal man's leaning toward the carnivorous type and diet, and because of his upright position and numerous environmental factors, the caeco-colon, so to speak, has outlived its usefulness, being but a vestigial remnant of the organ so essential to the herbivora. We do not find that this is true of the remainder of the great gut.

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Any other function possessed by the ascending colon and cæcum can be cared for by the caudad ileum. This is reasonably to be explained upon a biologic basis, for although differing widely in form, they have a common embryological origin.

In general, then, we may assume that the acquisition of certain intestinal malformations is evidence of hereditary predisposition. Some ill placed individuals, as we shall show later, yield to it, others do not. A plausible hypothesis as to the frequent occurrence of an ill adapted pseudo-herbivorous cæco-colon in man is perhaps that his remote ancestors were very imperfect in type and that these have perished. Mutations may arise *de novo*, and we are ignorant regarding their source. Man was unquestionably dark originally, the albino being a mutation.

All digestion takes place between the pylorus and the caudad ileum. Even the absorption of water, we have shown in our human experiments by ileostomy, not to be obligate as regards the colon. The reaction is acid in the ileum and alkaline in the cæcum. Human beings, after ileostomy, gain weight and pass solid fæces and odorless gas.

The basis for the foregoing is as follows. Case 180 (Lyon) Ileostomy for multiple polyposis, April, 1912. Six months after operation stool examinations showed nothing unusual except carbohydrate fermentation and a decidedly Gram-negative bacterial flora. The only enzymes found were amylopsin, decided, and steapsin, a faint trace. This has been confirmed by MacFaydyen, Nencki, and Sieber<sup>5</sup>. The reaction was tested daily for over a year and was found to be always acid. This is also supported by the authors above cited. They state, "Of noteworthy significance was the acid reaction throughout the whole length of the small intestine due to organic acids, chiefly acetic acid. The milk acids are neutralized by the alkaline producing mucosa. The neutralization of the HCl of the stomach takes place in the upper portion of the duodenum." Authors never found HCl. "All analyses showed that secretion of the small intestine contains natroncarbonate, and it was interesting to see in this patient how the mucous membrane of the ileum was alkaline in reaction but the contents acid. Alkaline reaction of the mucous membrane of the colon was much more intensive than that of the ileum. The alkaline reaction of the chyme begins in the large intestine." The importance of these observations, which are in accord with our own as regards bacterial growth in the ileum, cannot be overestimated.

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<sup>5</sup> MacFaydyen, Nencki, Sieber. *Archive fur Exp Path and Pharm*, 1891, vol. 28.

Ileostomy affords opportunity for critical study of the accuracy of X-ray findings as regards motility. There appears to be a difference in the time taken by bismuth and by ordinary food-stuffs to reach the cæcum. It is reasonable to expect a difference, bismuth being a substance foreign to the gut. Of the one hundred and sixty-four feeding experiments checked by carmine and charcoal made by Dr. Lyon, upon himself, the average time of first appearance at the stoma was 4 hours 57 minutes, the maximum being 6 hours, the minimum 4 hours 15 minutes. Addition of agar-agar gave 3 hours 45 minutes. Average time total emptying 11 hours 56 minutes, maximum 14 hours 30 minutes, minimum 8 hours 30 minutes. Consistency varied with food as follows. Meat diet yielded liquid stools, carbohydrate solid.

The following quotation from Dr. Lyon's observations upon himself are valuable. Shortly after operation and evidently before establishment of the vicarious compensation already referred to, he says, "Intense thirst generally during evening. After drinking eight or ten glasses am satisfied. At such times noted no change in the movements. Chicken and turkey leave more undigested muscle fibres than any other foods. Riding on trains always delays motility. Bananas of great value when bowel is sluggish."

One of the most interesting physiological observations to be made after an ileostomy has bearing upon referred pain. If the finger is passed into the ileac stoma or through the valve, pain occurs at the umbilicus and frequently over the splenic flexure. Nausea always and vomiting sometimes results.

Accidentally a concentrated stock solution of sodium chloride was poured into the colostomy of a physician. Severe pain in pit of stomach, shock, and collapse resulted. Intense thirst for 24 hours was followed by gradual recovery. After ileostomy, patients are able to detect immediately the entrance of even the smallest particle of ileac contents into the resting colon. Dr. Lyon found that dizziness, faintness, and cold sweats were the invariable subjective symptoms of this accident. The same symptoms but in less degree were brought on by inserting the finger into the colon. Every patient upon whom we have done ileostomy has experienced the same symptoms. Is it unreasonable to assume that certain of the familiar symptoms of so-called colonic toxæmia may be due to analogous mechanical conditions, whatsoever these may be?

In conclusion, we believe that the influence of heredity and environment upon the functional abnormalities of the human colon is paramount and that these fundamental biological factors are due further consideration. Attributing pathological conditions of the colon to any

single factor is a grave error, as isolated deficiencies may be compensated for. In the lower vertebrates, surgical physiology of the valvular mechanisms of the body proves that many complicated factors go to maintain the balance. The valve is the first line of defence, the physiological integrity of the tube is the second. Symptoms will not necessarily follow impairment of one, a valve is useful but not essential. In man, laboratory studies show that no matter how severe the derangement within the bowel, so long as compensation is maintained the body is protected, let the defensive power be weakened, however, and symptoms immediately arise. An excellent example of this has been noted by Bloodgood in his differing results following colonic resection for malignancy and benignancy.

Symptoms, therefore, are often misleading and in themselves are an inadequate basis upon which to form opinions for diagnosis. They must be carefully correlated with the facts of the fundamental sciences and their absence does not necessarily mean normal function.

**CASE HISTORY —Pre-operative Data**—Typhoid 17 years ago. One year later diarrhœa, 7 to 8 liquid stools a day. No blood. Winter intermission. This occurred for 3 summers. Total intermission for 5 years. Winter intermission until 1911. Then alternate diarrhœa and constipation. Noticed blood for the first time. Ten to 20 stools a day. Severe colicky pain relieved by stool. Localized at splenic flexure and left ileac region. Obligated to give up work owing to extreme nervousness and loss of mental coordination. Great physical prostration—in bed for weeks at a time.

*Operation*—Complete ileostomy.

*Post-operative Data*—1 Cessation of pain except at irrigation. This gradually disappeared.

2 Subjective symptoms. *Attacks of faintness*, clammy sweat, cold extremities, weakness and great prostration. Pulse rapid and at times irregular. In 8 minutes desire to defecate followed by small muco-sanguinous discharge with some relief of symptoms. Average duration of attacks 3 hours. Frequency of attacks varying from 1 to 3 a week, depending upon the amount of work done. These diminished in frequency and ceased after 6 months. Introduction of foreign body at stoma into resting colon caused same symptoms.

3 Thirst. Intense thirst for first 2 months gradually disappeared as movements became solid. Shows vicarious assumption of colonic function by ileum.

4 Urine. Until solidity of stool, urine markedly diminished. After solidification about 800 c c. Nitrogen partition made one

year apart at Cornell and Yale Laboratories showed normal metabolism

5 Sense of fecal discharge Absent until solidification of contents, and more marked after contraction of stoma Never painful

6 Character of stools Formed stools and often segmented showing layers of food stuffs

7 Reflex Occasional cardiospasm with burning sensation in stomach Occurs once or twice a month without apparent cause, lasting for 2 or 3 days, disappears spontaneously

8 Rectal discharge First 6 months irrigations every 12 hours Some bloody mucus without pain, always from the rectum, passed between these intervals Second 6 months, irrigations every 24 hours No discharge except when voiding irrigation Second year, daily irrigations, practical cessation of blood, and diminution of mucus End of third year, comfort with bi-weekly irrigations Discharge reduced to small amount of mucus with very occasional small blood clot

9 Work capacity Mental, carrying on regular professional duties Restoration of normal mental coordination Complete physical restoration Able to walk ten miles or row a boat all day

10 Food Intense hunger first year after operation, three heavy meals a day Second and third year normal appetite, food requirement about one-half what it was the first year

11 Effect of ordinary foods Nothing ordinarily interferes with solidity of stool

12 Effect of tainted food Ileostomy prevents the pain of so-called ptomaine poisoning, the first symptom being continual liquid stool

13 *Dressing*—Once a day on arising at time of irrigation No further attention until 3 P M Bag then emptied, it contains the breakfast Usually again at 8 P M This contains lunch And again upon retiring, this contains part of dinner Dressing consists of zinc oxide ointment and powdered starch Night dressing Cover abdomen with zinc oxide and powdered starch, make a quadrangular space with three-inch cotton roll, stoma at centre Cover with a layer of cotton, hold in place with a roller bandage over which place a many tailed bandage

14 Mechanical device A Delatour apparatus modified to prevent obstruction due to kinking of bag when sitting upright

15 Gain in weight First year 17 pounds, second year 6 pounds, third year stationary, total gain 23 pounds

16 Conclusions After solidification of the fæces, which occurs in six weeks, there is so little discomfort from an ileostomy as compared to relief from cessation of symptoms, that we unhesitatingly advise its employment

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*Additional Data*—Stool: 1. Odor: A slight sour odor never offensive; no fecal odor.

2. Reaction: External surface of faces alkaline; centre acid

3. Color: Varied with diet. Meat dark brown. Potato, dark brown. Baked beans apples, turnips light brown. Spinach, string beans, green. Crackers oatmeal, bread, milk, light yellow. Eggs, black.

4. Form of stool: At first liquid, in six weeks some formed stools. At the end of third year all formed except upon liquid diet.

5. Segmentation: At the end of three years the stools showed little segmentation.

6. Marking of stool: A capsule of carmine .3 grammes or charcoal given just previous to the meal. On certain foods as peas or corn, whose cellulose envelope remained undigested.

7. Time of appearance of foods: In 164 observations on a mixed diet the average time of first appearance was four hours and fifty-two minutes. Shortest time three hours and forty-five minutes. Longest time six hours.

8. Time of complete passage: In 164 observations was eight hours, thirty minutes was the shortest time and fourteen hours the longest, the average being about ten hours and thirty minutes.

Diet	First appearance	Last appearance
Turkey, potato, turnip, bread.....	4 hrs 30 min.	9 hrs 30 min.
Steak, mashed potato, bread .....	5 hrs	11 hrs
Scrambled eggs, toast, coffee . . . . .	5 hrs 15 min.	11 hrs
Roast veal, potato, bread, lima beans . .	4 hrs 30 min.	12 hrs.
Roast lamb, potato, bread, boiled rice ....	4 hrs 15 min.	9 hrs 30 min.
Sausage, wheat cakes, coffee . . . . .	4 hrs 40 min.	12 hrs

9. Time of movements: No regular time, but began from four and one-half to six hours after ingestion and continued until all had passed.

10. Test for enzymes: Amylose, very marked reaction; steapsin, faint reaction; trypsin, negative.

Solidity of stool: From 11 to 13 per cent. solids on mixed diet.

12. Absorption from colon: Thirty grammes of dry peptonoids in two ounces of water injected into rectum in knee-chest position at 11 P.M. Washed out with sterile water at 8 A.M., examination showed one-half of the sugar and nitrogen had disappeared. There was marked fermentation and therefore probably little absorption. Analysis of dry peptonoids:

Protein (N 6.25) (probably amino acids) . . . . .	39.81
Carbohydrates (mostly lactose) . . . . .	50.05
Water . . . . .	4.72
Ash . . . . .	5.32
Fats—extremely small.	

13 Effects of bismuth Patient given a meal and time of appearance noted The next day the same meal preceded by one-half ounce of oxychloride of bismuth Time of first appearance showed delay of one-half hour When one ounce was taken the delay was five hours

Experimental meal	appeared in 4 hrs 45 min
Experimental meal plus one-half ounce bismuth	appeared in 5 hrs 15 min
Experimental meal plus one ounce bismuth	appeared in 9 hrs 45 min

Lemonade A glass of lemonade caused an increased flow of bile as shown by abundant dark green liquid at stoma

Cathartics One-half ounce of Epsom salts caused a liquid stool at stoma in about two hours

## THE TRIANGLE OF PETIT IN KIDNEY SURGERY

BY HUGH CROUSE, M D.

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It is a grave mistake for a surgeon to attempt to adapt the patient to the technic instead of the technic to the patient, for it is not presumed that any single technic holds good in all forms of pathology in structures requiring surgical intervention. This article deals with a new route for kidney surgery, which, in the author's experience, has been successful in most pathological conditions met while dealing with the kidney in a surgical way, and is properly denominated the triangle of Petit route.

To utilize this route, make the skin incision as illustrated in (A) Fig 1, starting about three-fourths of an inch below the twelfth rib, slightly posterior to the anterior border of the latissimus dorsi, sweep straight down to within 1 inch of the crest of the ilium, then forward in a semilunar curve to about  $2\frac{1}{2}$  centimetres below and in front of the anterosuperior spine of the ilium. This incision should extend through the skin and adipose tissues only, retraction of which will expose the triangle of Petit at the lower portion of the straight incision, just as it begins to sweep forward. The anterior border of this triangle is formed by the external oblique muscle, the posterior border by the latissimus dorsi, and the inferior border by the crest of the ilium. The anterior floor of this space is formed by the internal oblique, the posterior border of which muscle is slightly anterior to or even with the anterior edge of the latissimus dorsi. When these muscles bounding the triangle of Petit have been exposed, the fingers of each hand of the operator should be forcibly pushed through the space between the external oblique and the latissimus dorsi, and the muscles forcibly and widely retracted, this retraction readily exposes the next structure—the lumbar fascia. The hands then being removed, forcible retraction of this area is made by the assistant, while the lumbar fascia is incised or nicked by the operator, in many cases this fascia can be punctured readily by the index finger, thus avoiding aid from the assistant. Again, with the fingers of each hand forcibly separate the latissimus dorsi, external oblique and lumbar fascia. Substitute a 3-bladed automatic retractor of the abdominal type for the fingers, with the auxiliary blade at the superior angle of the triangle of Petit, or the space made by the hand retraction of the operator,



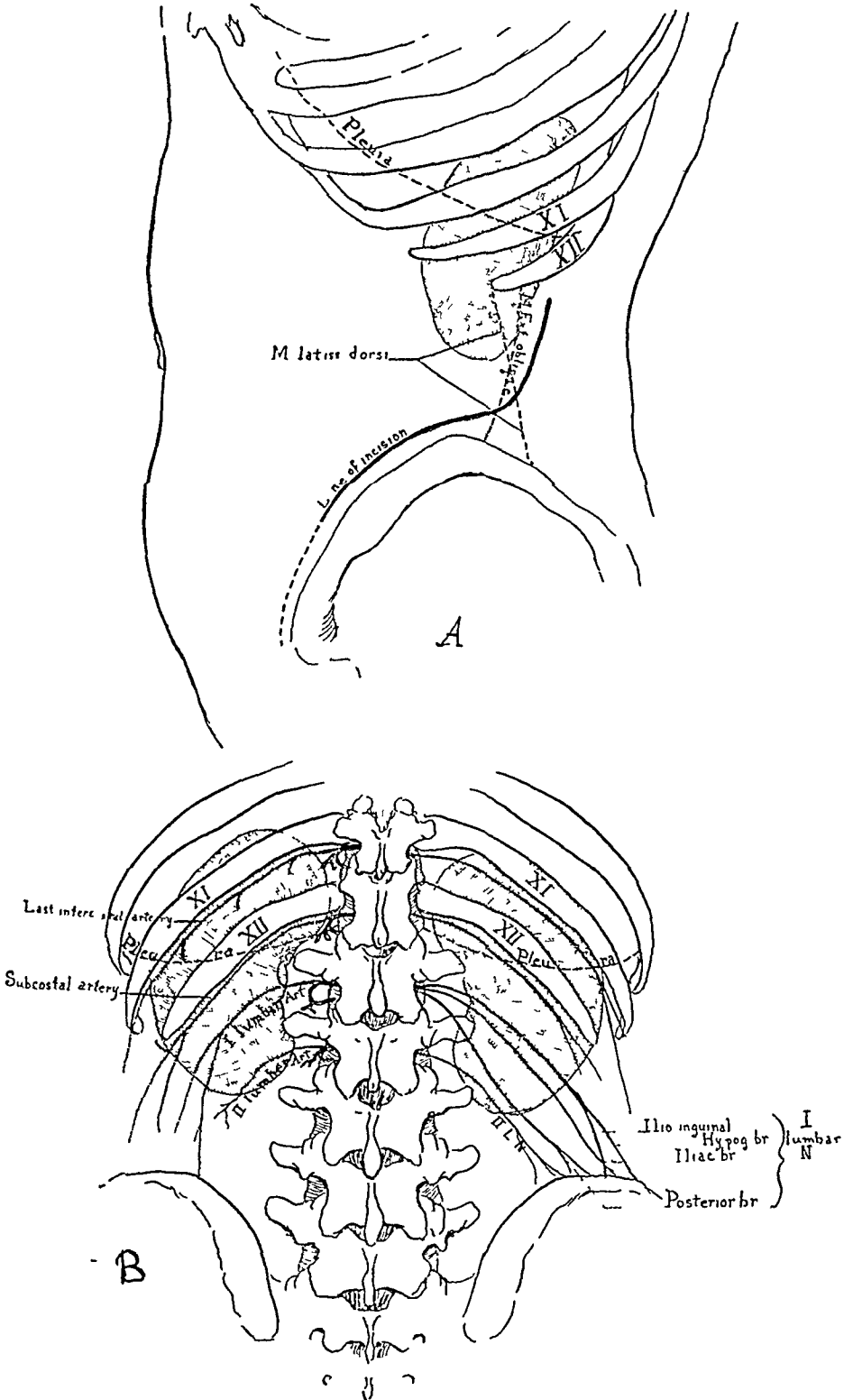


FIG 1 — 1 showing author's incision and schematic illustration of muscles and parts forming the triangle of Petit B, illustrating nerve and blood supply in lumbar region liable to injury during operation

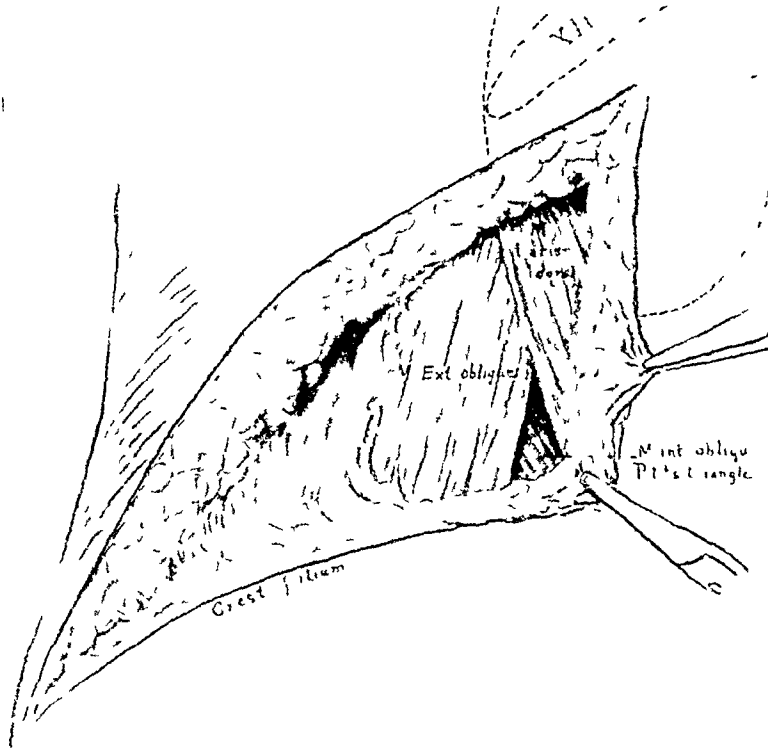


FIG 2 —Skin incision separated showing the triangle of Petit the muscles and crest of ilium bounding it

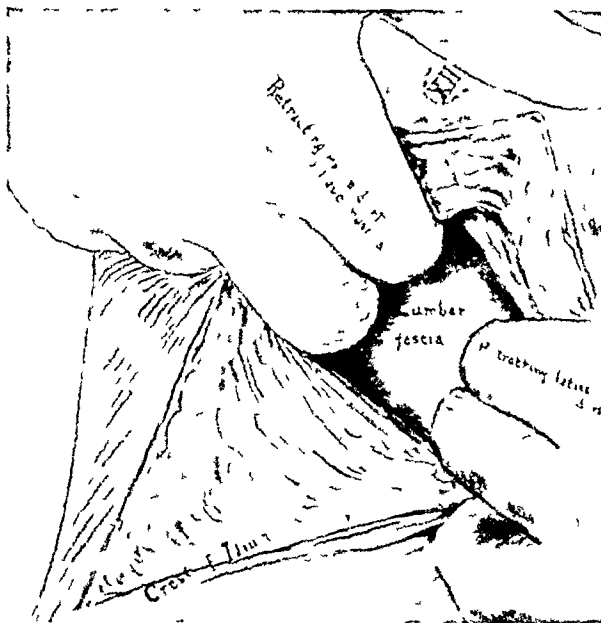


FIG 3 —Fingers of operator making retraction

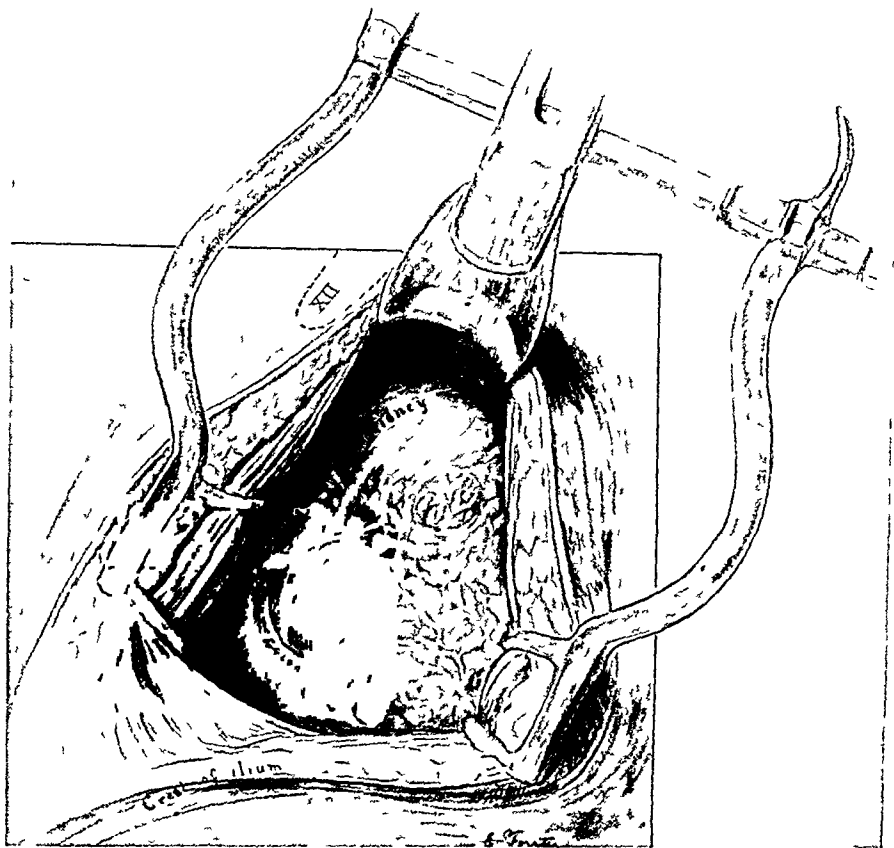


FIG 5—Automatic abdominal retractor separated showing left kidney descending colon and perirenal fat

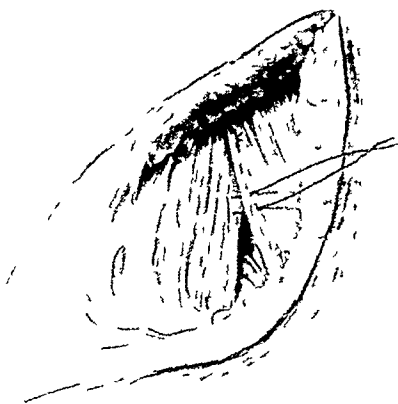


FIG 6—Muscles dropped back into position two mattress sutures closing

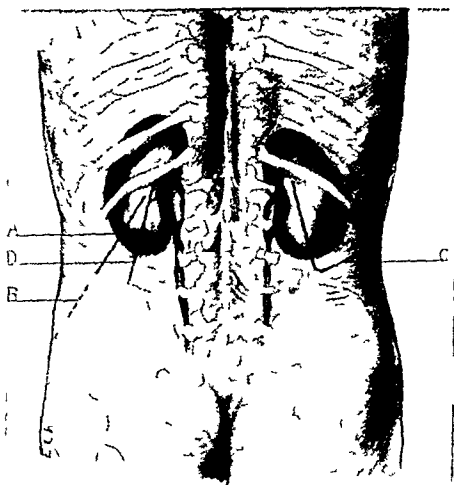


FIG 7—Incision for exposure of kidneys by the lumbar route A retroperitoneal exposure by oblique lumbar incision, B continuation of this incision where additional room is required, C, retroperitoneal exposure of Koenig's angular lumbo abdominal incision, D incision in Edebohls's operation of nephropexy (Bickham)

## THE TRIANGLE OF PETIT IN KIDNEY SURGERY

drop the two lateral blades into the space of the lumbar fascia, forcibly and widely retract the instrument, strongly pull up the superior blade, and the perirenal fat is immediately exposed. If the stretching has been sufficiently forcible, there is an anteroposterior operative area of about  $3\frac{1}{4}$  to 4 inches, which is amply wide to deal with the kidney in any way desired, whether nephropexy, nephrectomy or nephrotomy.

Among the different routes heretofore used in the foreign clinics is that of Koenig. His angular lumbo-abdominal incision (*A*, Fig 7) unfortunately not only incises the muscles, but at times necessarily injures the twelfth dorsal, the ilio-inguinal, and the iliac branch of the iliohypogastric nerve.

Mayo's incision—which is really a continuation of *D* (Fig 7)—is

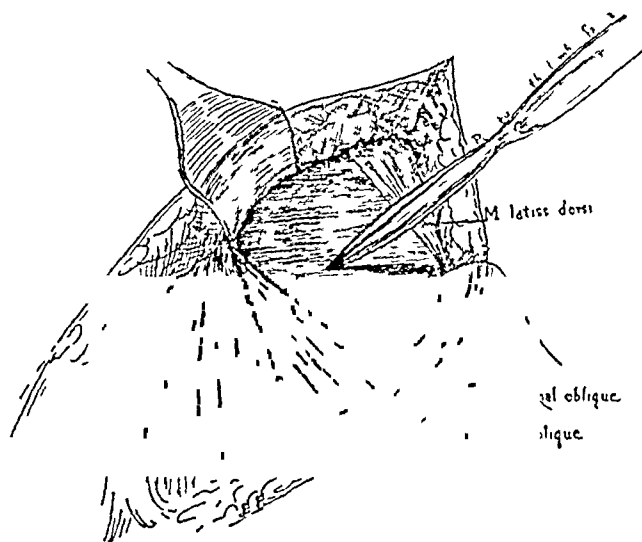


FIG 4 —Showing latissimus dorsi, external and internal oblique retracted, and lumbar fascia being punctured

too high, and at times necessitates removal of the twelfth rib, and is extremely liable to injure the twelfth dorsal nerve, with resultant paralysis of the abdominal group of muscles supplied by it. Judging from the number of cadavers examined by the author while investigating this point, Mayo's incision also has a tendency to open the pleural cavity, which in 65 per cent extended below the twelfth rib, and in several instances extended  $2\frac{1}{2}$  centimetres below the last rib.

Kelly's incision (*A* or *B*, Fig 7), even if one uses what he calls the lumbar angle, and which is mainly imaginary in an anatomical sense, necessitates incision of the muscles, and is liable to injure the ilio-inguinal, iliohypogastric and the twelfth dorsal nerve.

In the technic suggested by Edebohls (*D*, Fig 7), muscle-cutting and nerve incision also occur, and it does not afford the same facilities

for dealing with ureteral complications, or the wide operative field afforded by the triangle of Petit route. By this route the author has removed even a 14-inch kidney, which had been practically destroyed by suppurative degeneration secondary to calculi, and was compelled to cut only slightly the internal and external oblique to gain additional space. The author understands how one might find it necessary to incise also the internal and external oblique, when an excessive amount of perinephritic inflammation is encountered, in order to widen the triangle of Petit route.

On the right side this route can be used for doing appendectomies, and for inspection of the gall-bladder and duodenum. The left-sided incision gives access to the tail of the pancreas, the spleen and the splenic flexure of the colon. Confronted with the necessity of doing an appendectomy on a woman, seven months pregnant, and wishing to avoid abdominal weakening afterwards, the author studied the triangle of Petit, and selected it as a route that would avoid certain liability of post-operative hernia secondary to pregnancy and childbirth. The operation was successful, post-operative results fine. The author has used the triangle of Petit route in over 30 kidney operations in various forms of renal pathology, in several cases the duodenum has been inspected, the upper fourth of which is readily brought to view, when the retroperitoneum is opened and retracted with Payr's broad-bladed retractor or the silver malleable retractor so commonly used for exposing deep cavities. The gall-bladder can be drained and even removed, as was done by the author in the case of a very old person, suffering with a gangrenous condition of the gall-bladder. When the lateral position is maintained in bed after operation, this incision gives an ideal line for drainage.

The procedure for an appendectomy by this method is as follows. Retract backward the perirenal fat until the retroperitoneum is exposed, when the ascending colon can readily be seen shining through, by lifting up this retroperitoneum with tissue forceps, it can be nicked and stretched, use the ordinary anatomical guide of the ascending colon to find, secure and operate upon the appendix, then close the peritoneum with the purse-string suture, as in the ordinary gridiron appendectomy. Operative intervention completed, one need only remove the retractors, let the parts fall together, purse-string the lumbar fascia, cease retraction of posterior and anterior muscles, when the latissimus dorsi and external and internal oblique will drop back into their respective positions requiring only a couple of sutures to close (Fig 6). The lower angle of this triangle can be used for dam,

## THE TRIANGLE OF PETIT IN KIDNEY SURGERY

cigarette or tube drain, and the skin closed with Michel skin clips or horse hair, in the buttonhole method. The operation is now complete, without excessive traumatism or nerve injury, and frequently can be performed without ligating any blood supply other than that producing hemorrhage from the structure sought by the incision.

The author recommends this method and believes that it has marked advantages over the other incisions here illustrated, not only in rapidity, but in that it allows a return to normal anatomical relationship at completion of operation.

# OPERATIVE TREATMENT OF TUMORS OF THE BLADDER

CLINICAL RESULTS AS OBTAINED FROM A REVIEW OF 1702 CASES OF OPERATIONS ON TUMORS OF THE BLADDER BY VARIOUS OPERATORS DURING THE LAST FIFTEEN YEARS

BY JAMES A. GARDNER, M D  
OF BUFFALO, N Y

THE results of operations on tumors of the bladder during the past fifteen years, as presented in this paper, were gathered through the old method of sending blanks to a number of the leading urologists, asking for answers to certain specified questions. In this way the records of 369 cases have been procured. The records in many cases are not as complete as might be wished, owing to the lack of histories and the inability to keep track of patients, but upon the whole they are quite satisfactory.

Watson's report of 1160 cases,<sup>1</sup> which includes Beer's 183 cases treated by high-frequency current, Oudin, has been taken as the basis of this report. Since publishing his report and within the past five years Beer has seen 59 additional cases. Judd's report of 114 cases at the Mayo clinic is also included, which makes the total 1702.

The tumors of the bladder reported in this paper refer to those primarily in the bladder and not to malignancies which have invaded the bladder secondarily from other organs. In this series the tumors have been classified as follows: carcinomata, 178, papillomata, 175, sarcoma, 7, cysts, 4, polyp, 3, fibroma, 1, cystitis cystica, 1, total, 369. As would be expected, the great majority were carcinoma and papilloma. Tumors were present four times as frequently in the male as in the female. The average age at which they were found is about fifty years, being forty-seven and three-tenths for the papilloma and fifty-four years for the carcinoma.

Of the seven cases of sarcoma in this series two occurred at five and six and one-half years, respectively, the remaining five between the ages of thirty and seventy-three years. The results of operation in these cases were unsatisfactory, death occurring soon after operation except in one case where the patient lived four years.

The statistics regarding radium are too meager to justify drawing any conclusions, it only having been used in six cases and with little success except in one.

In operations on tumors of the bladder the surgeon has been greatly handicapped because of the inaccessibility of the tumor, it being most often found at the base of the bladder, near or involving the openings

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<sup>1</sup> Urologic and Cutaneous Review, vol. xvii, No. 2, 1913

## TUMORS OF THE BLADDER

of the ureters or the urethra Because of these difficulties these tumors have been attacked mainly by suprapubic excision of the growth, either by knife or cautery This method has been more or less successful with papilloma but not at all with malignancies These tumors all have a tendency to recur In papilloma 50 per cent recur in multiple,<sup>2</sup>—one large and a number of small ones Recurrences may not be recurrences but really primary growths which were so small that when the bladder was opened they were overlooked, while if treatment had been by intravesical high-frequency current they might have been recognized The smaller number of recurrences by intravesical operation than by the open method may be thus accounted for

TABLES OF OUR SERIES OF CASES  
CARCINOMA PARTIAL RESECTION OF BLADDER

No	Operative mortality, 2 months	Subsequent history	Recurrences	Freedom from recurrence
58	<i>Per cent</i> 15 or 27 5	41	<div style="display: flex; justify-content: space-between;"> <div> Under 3 years 18 or 43 9  Over 3 years 1 (4  years) 1 or 2 4 </div> <div style="text-align: right;"> 46 3 </div> </div>	<div style="display: flex; justify-content: space-between;"> <div> Under 3 years 15 or 36 5  Over 3 years 7 or 17 </div> <div style="text-align: right;"> 53 5 </div> </div>

CARCINOMA EXCISION OF GROWTH

86	<i>Per cent</i> 12 or 14	74	<div style="display: flex; justify-content: space-between;"> <div> Under 3 years 56 or 76 3  Over 3 years 4 or 5 5 </div> <div style="text-align: right;"> 81 8 </div> </div>	<div style="display: flex; justify-content: space-between;"> <div> Under 3 years 13 or 18  Over 3 years 1 or 1 </div> <div style="text-align: right;"> 19 </div> </div>
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TABLES OF TOTAL SERIES OF CASES  
CARCINOMA PARTIAL RESECTION OF BLADDER

No	Operative mortality, 2 months	Subsequent history	Recurrences	Freedom from recurrence
224	<i>Per cent</i> 42 or 18 7	146	<div style="display: flex; justify-content: space-between;"> <div> Under 3 years 60 or 41  Over 3 years 4 or 2 7 </div> <div style="text-align: right;"> 43 7 </div> </div>	<div style="display: flex; justify-content: space-between;"> <div> Under 3 years 50 or 34  Over 3 years 32 or 22 </div> <div style="text-align: right;"> 56 </div> </div>

CARCINOMA EXCISION OF GROWTH

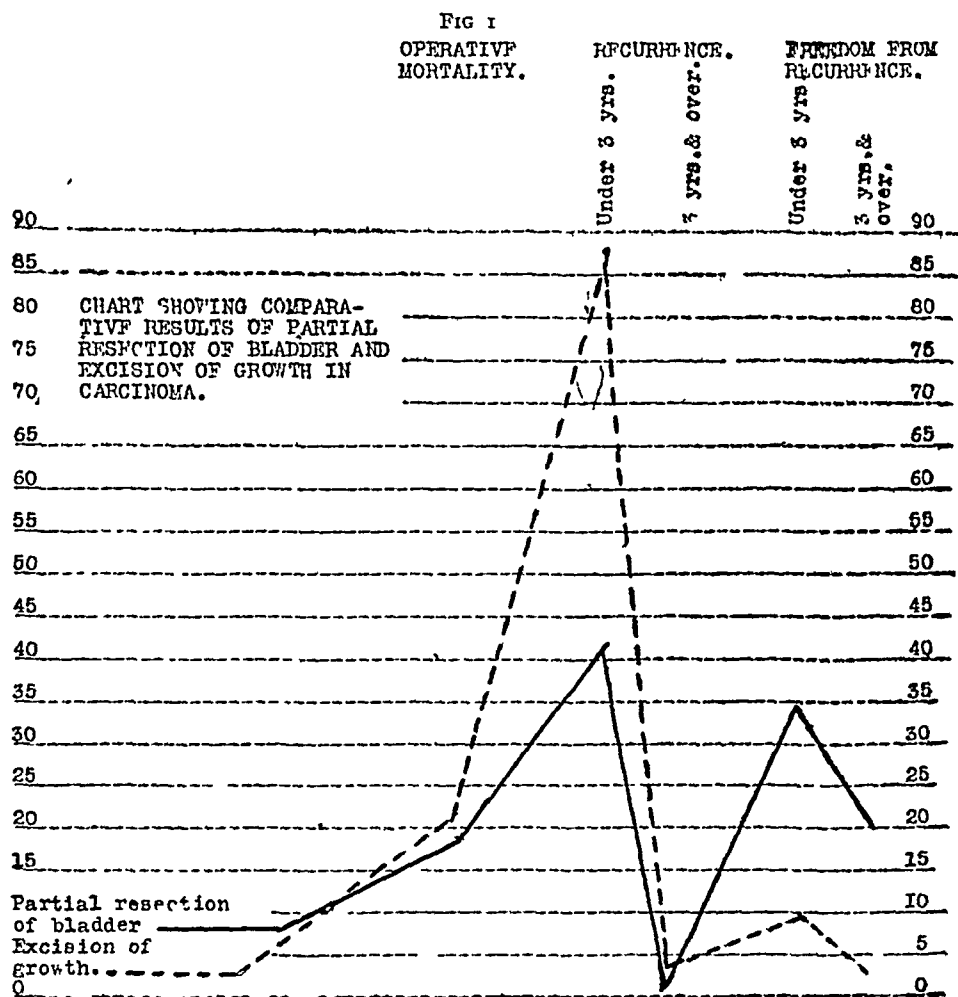
442	<i>Per cent</i> 90 or 21	201	<div style="display: flex; justify-content: space-between;"> <div> Under 3 years 172 or 85 5  Over 3 years 5 or 2 5 </div> <div style="text-align: right;"> 88 </div> </div>	<div style="display: flex; justify-content: space-between;"> <div> Under 3 years 19 or 9 4  Over 3 years 5 or 2 5 </div> <div style="text-align: right;"> 11 9 </div> </div>
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<sup>2</sup> Judd Journal Arkansas Med Soc. Sug, 1912



# JAMES A GARDNER

Carcinoma has been treated by various methods, the most common being suprapubic cystotomy with simple excision of the growth by scissors or curettage, removal by actual cautery, partial resection of the bladder after cystotomy, the more radical transperitoneal operation of the Mayo clinic, or Squier's subtotal cystectomy



In the treatment of carcinoma the tables at a glance show how much superior partial resection of the bladder is to excision of the growth. The mortality has been lower, recurrence has been much less and freedom from recurrence much greater than by suprapubic excision. Included in the cases of partial resection is a series of 63 cases in which the transperitoneal method was used, with a mortality of only 10 per cent, absence of recurrence at the end of three years 33 per cent and three patients alive five years after operation. This series is

## TUMORS OF THE BLADDER

a conclusive argument that transperitoneal resection of the bladder is the best method of partial resection

Resection of the bladder either by transperitoneal method, as performed at the Mayo clinic, or the subtotal resection of Squier opens up the field so that the ureters, enlarged glands, and any metastases may be easily recognized before the bladder is opened, and if transplantation of the ureters is necessary, which is often the case, they are easy of access

Included in our series are four total cystectomies and one preliminary transplanting of the ureters into the loin as the primary step. In four of these cases the ureters were transplanted into the loin and in one into the sigmoid. Three of the five died as a result of the operation, one after preliminary transplantation of the ureters into the loin, from hyperstatic pneumonia and renal insufficiency, another who had implantation into the loin died of shock, and the third patient, where the ureters were transplanted into the sigmoid, also died of shock. Unfortunately total cystectomy seems to be reserved as a last resort and the mortality from the operation in patients *in extremis* is of course very high. In cases where this operation is indicated and patients operated upon earlier, it would seem that Watson's two-step operation of first implanting the ureters into the loin will give more satisfactory results.

Squier, McCarthy, Pilcher and others have used the D'Arsonval high-frequency current upon the base of malignant tumors, after first removing the tumors with actual cautery through a suprapubic incision. Percy advocates the heat treatment for carcinoma of the bladder, using the same technic he uses for malignancies in the abdominal cavity. Few cases have been reported, however, and sufficient time has not elapsed to allow us to judge whether this method is more advantageous than excision of the growth by actual cautery, which has not proven a marked success.

Primarily the papillomata may be benign but potentially are malignant and will become so if the patient lives long enough. Pathologists report cases in which one part is benign and another part is found to be malignant. They also state that a negative report as to cancer means no more than a negative report on sputum examination for tubercle bacilli. In the face of this difficulty, which method of operation will show the least recurrence?

In the treatment of papilloma Beer's method of high-frequency current has been received as a marked step in advance. High frequency has many advantages because of its simplicity and because it obviates hospital care and confinement. The operative mortality is practically

nil In our own series it amounts to seven-tenths per cent, which is created by one case occurring in my own practice It seems but fair to mention this fact, inasmuch as this case was the only one in the total series of 338 cases, including those of Dr Beer, in which death resulted from treatment Dr Victor Pedersen reports a case of carcinoma in which, after cystotomy, D'Arsonval current was used successfully in excision of the growth until the patient was shocked by contact between the electrode and the retractor Patient survived operation about eight hours but never recovered from the shock which seems to have begun and was gradually increased by the electrical contact spoken of These two cases are the only ones the writer has found where any accident has resulted from its use

Freedom from recurrence during the short time it has been in vogue is much greater than by the open method of operation In Beer's report of 183 cases there was much less percentage of recurrence during the first year than by the other methods of operation Since then he has seen 59 additional cases and we have 71 which have been treated by the high-frequency method

PAPILLOMA EXCISION OF GROWTH

No	Operative mortality, 2 months	Subsequent history	Recurrences	Freedom from recurrence
96	<i>Per cent</i> 6 or 6.2	87	<i>Per cent</i> Under 1 year 10 or 11.4 Under 2 years 6 or 6.9 Under 3 years 9 or 10.3 Under 4 years 2 or 2.3 Under 5 years 2 or 2.3 Under 7 years 2 or 2.3 <hr/> 35.5	<i>Per cent</i> Under 1 year 15 or 17.2 Under 2 years 18 or 20.6 Under 3 years 5 or 5.7 Under 4 years 6 or 6.9 Under 5 years 3 or 3.4 Under 6 years 2 or 4.6 Under 7 years 2 or 2.3 Under 8 years 2 or 2.3 Under 11 years 1 or 1 <hr/> 64

PAPILLOMA HIGH-FREQUENCY CURRENT

No	Operative mortality	Under treatment	Treatment not effective	Subsequent history	Recurrences	Freedom from recurrence
71	<i>Per cent</i> 1 or 7	3	2	61	<i>Per cent</i> Under 1 year 2 or 8.2 Under 4 years 2 or 4.9 <hr/> 13.1	<i>Per cent</i> Under 1 year 12 or 19.6 Under 2 years 21 or 34.4 Under 3 years 15 or 24.5 Under 4 years 3 or 4.9 Under 5 years 2 or 3.2 <hr/> 86.6

## TUMORS OF THE BLADDER

Dr Beer after examining some of his earliest cases, which were treated four years ago, reports no signs of recurrence. Among our cases there are two of four years and over and three between three and four years without recurrence. This series shows that there is a marked difference in favor of high frequency in the absence of recurrence during the first three years than by the open method of operation. In our series there were 15 cases of carcinoma in which the spark was tried, 5 in which diagnosis was papilloma and discontinued

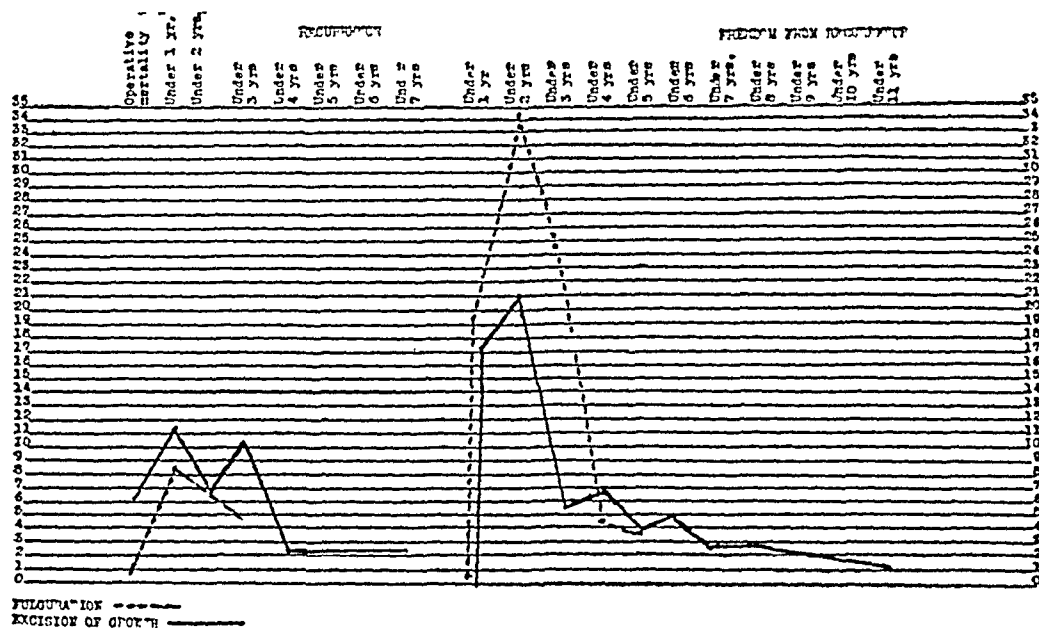


FIG 2 —Chart showing comparative results of excision and fulguration upon papilloma.

when the diagnosis of carcinoma was made. In the other 10 it was used intentionally as a palliative but in only 3 was there any relief from the symptoms. This bears out Beer's statement that high frequency is not applicable to malignant growths in the bladder. Dr H. Meyer has reported a series of 25 cases of papilloma treated through operating cystoscope with snare followed by electric cauterization with results that compare very favorably with fulguration, having one case ten years without recurrence.

Beer emphasizes<sup>3</sup> the importance of selection of cases because he states that he does not believe malignant neoplasms can be cured by intravesical high-frequency current. This conclusion has been borne out by Keyes and other urologists of large experience.

In the treatment of papilloma the question is purely one of diagnosis. Up to the present time the statistics decidedly favor treatment

<sup>3</sup>Journal Am Med Assn, No 16, 1912

by intravesical high-frequency current against excision, but it is early to draw a comparison between these two methods because of the short time high frequency has been in use

In our series eight cases were diagnosed papilloma by operators which were shown by pathological examination to be carcinoma In 13 cases, 11 of which were confirmed by microscopical examination, the growths were treated as papilloma and recurred as carcinoma Because of the difficulty in procuring proper specimens for microscopical examination and the knowledge that these specimens may be from a benign portion while some other part of the tumor may be malignant, and because the report of the pathologist does not carry assurance that the tumor is benign, diagnosis is rendered difficult and uncertain If we are able to diagnose positively that a growth is papilloma, high-frequency current is our best method, but until a more accurate method of diagnosing is provided,—until some blood test allied to the Wassermann or the complement fixation test is discovered which will establish the character of the growth beyond question,—there must exist an uncertainty as to the best procedure

#### CONCLUSIONS

First In treatment of carcinoma the transperitoneal method as used in the Mayo clinic or the subtotal cystectomy of Squier, with wide resection of bladder wall, offers the best method These methods give the operator opportunity to look for enlarged glands or metastases and if necessary the ureters can be easily transplanted

Second Cystotomy and excision and actual cautery should only be used in terminal cases as a palliative method to relieve pain and hemorrhage

Third When the growth involves both ureters Watson's operation of total cystectomy with a primary operation for transplanting the ureters into the loin shows the best results

Fourth In the treatment of papilloma, intravesical high-frequency current during the short time it has been used has given better results than any other method, reserving the question for time and statistics to determine whether this method by reason of the difficulty in distinguishing between papilloma and carcinoma is shown to be as satisfactory as wide resection, such as is advised for carcinoma

No	Year	Results	Method of operation	Discharge
Surgeon, L T F				
1	1908	Lived 14 months following operation. Death from septicaemia	ope, snare followed by cautery	
2	1912	after operation, no evidence of	ope, snare followed by cautery only	
3	1912	symptoms cleaned up, after tumor size Examination one year the same	several places with large, flat operating cystoscope	
4	1914	dis without recurrence	cope, snare, followed by cautery	
5	1914	colic-vesical fistula at time of Post-mortem and pathological	cope, snare, followed by cautery	
6	1914	pilloma	cope, snare, followed by cautery	
Surgeon, A Nell				
7	1909	after	cope snare followed by cautery	
8	1913		cope, snare, followed by cautery	
9	1911	years	stomy	
10	1912	discontinued treatment		
11	1912	rs		
12	1911		ious places with large cautery cystoscope	
Surgeon, J C H				
13	1911	operation, lived 30 months, died	scope, snare, followed by	
14	1912	adder 9 months after operation	stomy and cauterization	Permanent
15	1913		ope, snare, followed by cautery	
16	1913		ope, snare, followed by cautery	
17	1914		ope snare, followed by cautery	
18	1914	tent	ope, snare followed by cautery	
Surgeon, W S				
19	1914	now still remains in original location	ope snare followed by cautery	
Surgeon, E R				
20	1902	years from hemorrhage	cope with cauterization	
21	1906	rs		
22	1912		ope, snare followed by cautery	
Surgeon, E O				
23	1911	three years, no recurrence	ope, snare, followed by cautery	
24	1912	rs	ope snare, followed by cautery	
25	1912		ope, snare, followed by cautery	
26	1913	with involvement of abdominal lymph nodes	age	
27	1914	ments, recurrence in 5 months, recurrence in 5 months	age	
Surgeon, F Bie				
28	1913	at other points two small papillae	bicially, fulguration of stump	
29	1914	aths	age of growth	
30	1914	operation one month following, for 18 hours following second	stomy and radium in small	
Surgeon, C Bet				
31	1914	hs later	ble seemed to hasten growth	
32	1914	after operation	ubically	
33	1914	hemorrhage		
Surgeon, M B				
34	1913	years	stomy	
35	1914	rs	stomy with resection of a square inch	
Surgeon, T M				
36	1903	ic cellulitis	urd wall bladder	
37	1904	cebral embolism	urd wall bladder	
Surgeon, G H				
38	1914	after	ncy current, no benefit, have	
Surgeon, C M				
39		years	radium	
40		years	no benefit, radium	
41				
42				
43				
44				
Surgeon, B Te				
45	1902	general carcinomatosis	stomy, with removal of tumor,	
46	1903	rs afterwards, general carcinoma	ture to pedicle	
47	1907	extension to intestines and ab-	stomy with removal of tumor	Permanent
48	1910	(?)	stomy with removal of tumor, and cut, base cauterized	Permanent

by intravesical high-frequency current against excision, but it is early to draw a comparison between these two methods because of the short time high frequency has been in use

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No	Year	Age	Sex	Classification of tumor	Method of operation	Dr
Surgeon, H Meyer						
49	1905	32	M	Papilloma	Operating cystoscope, snare, followed by cautery	
50	1907	30	M	Papilloma	Operating cystoscope, snare followed by cautery	
51	1908	34	F	Papilloma	Electric cautery only	
52	1908	45	M	Large translucent cyst	Perforated in several places with large, flat cautery on operating cystoscope	
53	1908	34	M	Papilloma	Cautery through operating cystoscope	
54	1909	54	M	Papilloma	Operating cystoscope, snare, followed by cauterization	
55	1909	51	M	Papilloma	Operating cystoscope, snare, followed by cauterization	
56	1909	46	M	Papilloma	Operating cystoscope, snare, followed by cauterization	
57	1909	41	M	Papilloma	Operating cystoscope, snare, followed by cauterization	
58	1910	44	M	Papilloma	Operating cystoscope, snare, followed by cauterization	
59	1910	50	M	Carcinoma	Suprapubic cystotomy	
60	1910	50	M	Polyp	Snare only	
61	1910	37	M	Large cyst	Perforated in various places with large cautery on operating cystoscope	
62	1910	43	M	Papilloma	Operating cystoscope, snare, followed by electric cautery	
63	1911	46	M	Carcinoma	Suprapubic cystotomy and cauterization	Perman drain
64	1911	32	F	Papilloma	Operating cystoscope, snare, followed by cautery	
65	1911	54	F	Papilloma	Operating cystoscope, snare, followed by cautery	
66	1912	28	F	Papilloma	Operating cystoscope, snare, followed by cautery	
67	1912	48	M	Papilloma	Operating cystoscope, snare, followed by cautery	
68	1912	24	M	Papilloma	Operating cystoscope, snare followed by cautery	
69	1912	40	M	Papilloma	Operating cystoscope, snare followed by cautery	
70	1912	54	M	Papilloma	Operating cystoscope, snare, followed by cautery	
71	1912	49	M	Papilloma	Operating cystoscope, snare, followed by cautery	
72	1913	46	M	3 cystic outgrowths at neck of bladder	Operating cystoscope with cauterization	
73	1913	35	M	A large translucent cyst through operating cystoscope, punctured with cautery		
74	1913	18	M	Papilloma	Operating cystoscope, snare followed by cautery	
75	1913	32	M	Papilloma	Operating cystoscope, snare, followed by cautery	
76	1914	36	F	Papilloma	Operating cystoscope, snare, followed by cautery	
77	1914	52	M	Papilloma	Operating cystoscope, snare, followed by cautery	
78	1914	31	M	Papilloma	Operating cystoscope, snare, followed by cautery	
79	1915	32	M	Papilloma	Operating cystoscope, snare, followed by cautery	
Surgeon, G S Gordon						
80	1909	48	M	Cancer involving right ureter	Suprapubic drainage	
81	1911	60	M	Cancer involving internal sphincter	Suprapubic drainage	
82	1913	33	M	Cancer	Removal suprapubically, fulguration of stump	
83	1909	59	M	Cancer involving right ureter	Suprapubic drainage	
84	1911	55	F	Cancer involving roof of bladder and enlarged pelvic glands	Partial removal of growth	
85	1912	55	M	Cancer involving right ureteral orifice	Suprapubic cystotomy and radium in small amounts available seemed to hasten growth	
86	1911	24	M	Papilloma	Removed suprapubically	
87	1912	54	M	Carcinoma (?)	Fulguration	
Doctor, New York City						
88	1902	28	M	Multiple papilloma	Suprapubic cystotomy	
89	1906	62	M	Carcinomatous	Suprapubic cystotomy	
90	1909	32	M	Papilloma	Transperitoneal with resection of a square inch of bladder wall	
91	1910	66	M	Sarcoma	Resection one-third wall bladder	
92	1912	68	M	Carcinoma	Resection one-third wall bladder	
93	1914	30	M	Multiple papilloma	Tried high-frequency current, no benefit, have given 200 mgm radium	
94	1914	72	M	Large carcinoma	High-frequency, no benefit, radium	
Surgeon, E L Keyes Jr						
95	1886	63	M	Globular tumor 2 inches in diameter pedunculated, attached to base with many smaller growths	Suprapubic cystotomy, removal of tumor and curettage	
96	1891	51	M	Soft pedunculated tumor weigh ing 3 1/2 ounces	Suprapubic cystotomy with removal of tumor, clamp and ligature to pedicle	
97	1900	60	M	Large villous cauliflower growth filling bladder and attached to base	Suprapubic cystotomy with removal of tumor	Perman fistul
98	1901	43	M	Fulminating tumor attached by broad base to left lateral wall	Suprapubic cystotomy with removal of tumor, pedicle ligated and cut, base cauterized	Perman fistul



Examination of urine	Were specimens examined microscopically?	Results
	Papilloma suggesting malignancy	Cystoscopy two years later bladder showed some little pads around the bladder outlet Reported a few months ago that he was free from trouble Reported as well two years after operation
	Carcinoma	Patient was fairly comfortable for a year, since then a good deal of distress Died February 17, 1915
	Papilloma	Died of embolism on fourth day after operation
	No	Was well a year or more after operation
	Papilloma	Was comfortable for a year, then blood Cystoscope showed a recurrence High-frequency did not control
	Papilloma	Died of uræmia or gastro-mesenteric ileus a few days after operation Second operation on above case
	No	Well a year later
	Papilloma	No symptoms December 26 1914
	Papilloma	Reported as well some months later
	No	Was living nearly a year later Not heard from since
	Papilloma	Patient showed no sign of recurrence over a year later
implantation eters	No	One year later was comfortable and cystoscopy showed no signs of recurrence at that time
	No	Died 11 months later Autopsy showed double pyonephrosis Great glandular masses in pelvis behind the peritoneum
	No	Patient died 48 hours after operation supposedly of shock and renal insufficiency No autopsy
	No	Patient reports himself well a year later
	Carcinoma	Eight months later cystoscopy showed no signs of recurrence
	Carcinoma	Patient recovered enough to leave hospital but died about two months after operation No autopsy
	Carcinoma	There is no sign of recurrence cystoscopically but patient is going down hill and I believe cannot live long (Died January 29 1915) Is sugar free
	No	Patient's condition was reported as satisfactory a few weeks ago Has not been cystoscoped
	No	No report in seven weeks
	No	Patient first operated on suprapubically five years ago for a large papilloma Recurrence two years ago treated with high frequency This is second recurrence Operation 10 days ago, patient since died had a hypostatic pneumonia I think he also had more or less renal insufficiency
eters transplanted loins	No	Died 11 months after, cachexia
	Yes	
	Yes, reported benign	Died 3 months later, cachexia spinal cord metastasis
	Yes	No recurrence, living 1 year 10 months after Cystoscoped last April 1914
	Yes	No recurrence, living Last cystoscopy May 1914, 3 years after treatment
	Yes	No recurrence, living Last cystoscopy December, 1914, 3 years after treatment
	No	No recurrence, living Last cystoscopy February, 1914, 2 years after treatment
	No	No recurrence, living Last cystoscopy December, 1912, 9 months after treatment
	Yes	Well till October 1914, then recurrence of hæmaturia Operated by another physician and a carcinoma found in another part of bladder
	Yes	Recurrence 6 months later, living Last cystoscopy August 1914 19 months later
	Yes	No recurrence, living Last cystoscopy August, 1914 one year later
	Yes	No recurrence, living Last cystoscopy August, 1914 15 months later
	No	No recurrence, living Last cystoscopy May, 1914 one year later
	Yes	No recurrence, living Last cystoscopy June 1914 13 months later
	No	No recurrence living Last cystoscopy March, 1914
	No	No recurrence, living Last cystoscopy July 1914 11 months later

# SUPRAPUBIC PROSTATECTOMY IN TWO STAGES\*

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THE removal of the hypertrophied prostate in two stages, through a suprapubic incision, has become a well recognized procedure by an ever-increasing number of surgeons in this country, and is beginning to be introduced into the clinics abroad. Though much has been written on this subject in the past ten years, a complete historical paper has never been attempted. As the writer was among the very first to practise and to advocate the operation, it has seemed to him that a thorough review of the work done along these lines would be of value not only historically, but would also tend to still further increase the popularity of the procedure. No doubt due to the absence of such a paper, numerous articles have appeared, both here and abroad, in which the operation as we practised it ten years ago is very accurately described as a new procedure. This has happened so frequently and so repeatedly, and even so recently, that no further apology for this paper need be made.

Suprapubic prostatectomy in one stage dates back to 1886 and 1887, when Belfield, of Chicago, and McGill, of Leeds, published their first cases. McGill removed obstructing portions of the prostate and gradually increased the amount removed until he did a complete prostatectomy. Belfield added a perineal incision for drainage. Fuller, of New York, and Freyer, of London, deserve credit for developing and carrying out successfully the present operation for enucleation of the prostate through a suprapubic incision at one sitting. The great epochs in the development of suprapubic prostatectomy are (1) McGill and Belfield's original work in 1886 and 1887 (2) The abolition of vasectomy, castration and the Bottini operation (3) The introduction of urinary antiseptics (4) The two-stage operation.

*Historical Considerations*—The writer's first two-stage prostatectomy was done in September, 1903, and was reported in a paper on "Suprapubic Prostatectomy under Nitrous Oxid Anæsthesia," published in the *Journal of the American Medical Association*, May 14,

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\* Read before the Harlem Medical Association of New York.

1904 In that paper I said "In one of my cases there were daily chills as a result of a severe cystitis, and the urine contained a large amount of pus After draining the bladder for ten days, the prostate was removed *in toto*, and the man made a splendid recovery And that is just one of the advantages of the operation, that we can, in badly infected cases, first relieve the cystitis, and then, through the same opening, remove the prostate in a very few minutes" This was written in 1904 The details of the case may be of interest, as I had up to that time neither heard nor read of a two-stage prostatectomy In all justice I should say that the character of the operation was forced upon me by the exigencies of the case

M L M, seventy-five years old, referred by Dr Henry S Stark In 1898 he suffered for two months from frequent and painful urination Following this attack he was no longer able to pass his water, and thereafter had been catheterizing himself four or five times daily During this time he had had frequent attacks of cystitis and orchitis During the five days prior to his admission to the hospital the patient had an unusually severe attack of cystitis He had a chill every day, accompanied by fever, anorexia, irregular pulse and a marked general depression The urine withdrawn from the bladder contained large amounts of pus, and the catheter had to be passed every two hours I was asked to see the man, not with the view of operating on him, as he was considered to be beyond the hope of cure, but simply to satisfy the relatives By rectum the prostate was found considerably enlarged The man's desperate condition precluded a radical operation At the same time it was evident that if something were not done promptly he would die of sepsis Suprapubic cystostomy was offered and accepted as a palliative procedure On September 15, 1903, under eucaime and laughing gas, this operation was carried out Three days later the man was allowed to sit up for an hour His temperature became normal, the pus gradually disappeared from the urine, and his general condition improved materially We were then confronted by the problem as to whether anything further could or should be done In spite of his seventy-five years the man was still attending to his affairs, which necessitated his being out most of the day After careful consideration, it was decided to do a prostatectomy under gas, through the incision which had already been made This was done eleven days after the preliminary operation The prostate was found firmly adherent to its capsule, and required considerable force for its removal A gauze packing was left in the bladder The operation consumed eight minutes, and was accompanied by very little bleeding The tumor consisted of two lateral lobes, each the size of a small plum, and about an inch of urethra ran through the gland Three days after the second operation the patient developed a bronchopneumonia of moderate severity In ten days the temperature was again normal, and thereafter convalescence was rapid and uninterrupted Four months after operation the man had gained 33 pounds, he was able to hold his water over four hours during the day and six hours at night, and there was no residual urine This patient lived to be over eighty years and had no further urinary disturbances

## SUPRAPUBIC PROSTATECTOMY IN TWO STAGES

My second case was done in April, 1904, and was reported in a paper on Suprapubic Prostatectomy, in the *ANNALS OF SURGERY*, April, 1905. In this case the bladder was distended with blood clots and I deliberately advised the two-stage operation. The bladder was drained for ten days, and the entire prostate was removed at the second stage in less than two minutes. This man, who was seventy-five years old, lived to be over eighty with no further bladder trouble. Dr. Howard Lilienthal, in the *ANNALS OF SURGERY*, April, 1905, wrote "The operation may be performed in two stages, which may be of enormous value in hemorrhage, in uræmia or in grave sepsis of the bladder, where catheterization is difficult, or painful, or dangerous." He further stated, "I have since employed this two-stage method to my great satisfaction, and I believe it to be one of the important advantages of the suprapubic operation." Chetwood, under Prostatectomy in Two Stages, in the *ANNALS OF SURGERY*, October, 1906, describes it as a conservative operation with minimum hazard. Chetwood did not refer either to Dr. Lilienthal's paper or to my two papers. This drew forth a letter of Lilienthal in the *Medical Record*, December 8, 1906. In this letter he drew attention to the fact that he had done his first two-stage prostatectomy in 1896. This case was not reported at the time, and I was not able to find the report of any other case prior to 1903 when I did my first case.

The late Follen Cabot in 1907 wrote of the two-stage operation "To my mind this method is of great value, and from my own experience with it, I believe it will be used more and more as its merits are better understood. I am also convinced that ether anæsthesia is the cause of many deaths in prostatics from kidney and lung complications following operation." He further stated that he would in future do the first stage under local anæsthesia. The writer recognized this fact at the very beginning of his work in this line, and was the first to advocate and to practise the operation without ether or chloroform. In fact all the writer's prostatectomies, both the one-stage and the two-stage operations, have been done either under local anæsthesia or under laughing gas.

It is really astonishing how long it took for foreign surgeons to recognize the value of this operation. A rather careful search of the foreign literature revealed but few reports, and even then it was usually recommended only for infected cases or for bad risks. Carlier, of Lille, in 1908 advised the two-stage operation in infected cases, and suggested an interval of several weeks between the two stages. In the same year Lanz, of Amsterdam, reported three badly infected cases

done under local anæsthesia. Done in this way he places the procedure in the category of "*ungefährliche Operationen*" Cholzoff, of St Petersburg, reported in 1910 that his mortality had been so much reduced by the two-stage operation that he had given up the operation at one sitting. He was led to this by the following experience. In eleven consecutive cases of operation in one stage he had three deaths. He then did twenty consecutive two-stage operations with only one death. Thereafter he always did the two-stage operation. He found considerable shock after the one stage operation even in patients in relatively good condition. He cites among the advantages of the newer operation, that after the first stage the inflammatory process in the bladder and kidneys subsides, absorption of toxic products ceases, the pressure of the dammed-back urine on the kidney parenchyma is relieved, and kidney function improves. Several of his cases before the first stage showed insufficient renal excretion, yet all these cases gradually improved after the preliminary cystotomy. He often waited three weeks before doing the second stage.

Kayser, reporting from Kummell's clinic in Hamburg in 1911, deplotes the fact that the two-stage prostatectomy has not found more favor in Germany. He reported four cases, using only local anæsthesia. He cites three principal reasons for doing the operation. First, the age of the patient requires us to reduce shock to a minimum. Second, it enables us to treat the infected bladder and to relieve the kidneys that have been damaged by an ascending infection, or by the damming back of the urine. Third, it diminishes the danger of wound infection. Judd, reporting from the Mayo clinic in 1911, writes, "During the past few years we have not only been able to reduce our mortality materially but have secured a more satisfactory convalescence and better results. With a permanent catheter in the urethra, or through a suprapubic stab wound, we divide the treatment into two stages, relieving the secondary symptoms first. This will enable the patient to eat, drink, sleep and improve generally in health. The second stage will be accomplished more satisfactorily and with more safety than if the preliminary treatment had not been instituted."

Lilienthal, in 1910, reported sixteen cases of the two-stage operation, in which the longest interval between the two stages was twenty days, and the shortest two days, with an average period of eight days.

In 1912, and again in 1914, P. M. Pilcher, of Brooklyn, advocated the two-stage operation as the operation of choice.

Freyer, of London, in 1912 after reporting one thousand cases of suprapubic prostatectomy, stated that in some cases he did the operation

in two stages. But he did not state the proportion of cases in which he did it, or what his indications were for so doing.

From the above papers, which fairly well cover the literature on this subject, it will be seen that the two-stage prostatectomy is slowly but surely becoming the operation of choice with an ever increasing number of surgeons. But, unfortunately, some still do the one-stage operation in many of their cases, and as a result, lives that should be saved by prostatectomy are added to the mortality list of the operation. There can be no doubt in the mind of any surgeon who has done the two-stage operation, often in desperate cases, that the mortality is appreciably lowered by that procedure. In regard to our personal experience, following the first two cases referred to above, we have resorted to the operation in an ever larger percentage of cases, until now we look upon it as the operation of choice in all cases of prostatic hypertrophy. And we have been led to this not only by our own experience, which we may say parenthetically was very satisfactory with the one-stage operation, but also by the experience of others, whose work we were able to follow. Whenever of late years we have heard of a death a few days after a primary prostatectomy, the question at once presented itself, would this man have died if the operation had been done in two stages? And we are glad to say that we have occasionally been able to persuade a surgeon that his patient would have had a better chance had that been done. And we have had a goodly number of cases ourselves who would certainly have succumbed if we had not done the operation in two sittings.

Some men say that if the patient is in good condition they do the operation at one sitting. How do we ever know that any of these old men are in good condition? We can make as many tests as we wish to determine the functional capacity of the kidneys—all of them will sometimes leave us sadly in the lurch in determining the ability of the patient to overcome the shock of operation. The same can be said of the most careful examination of all the other organs of the body. The cases that seem the poorest risks will sometimes show surprising resistance, while some of those apparently in good condition succumb to shock. I must confess that I cannot tell beforehand which of these cases is going to be badly shocked and which is not. Some of the most desperate cases, even well over 75 years old, have little or no shock. Others, younger and apparently in relatively good condition, are badly shocked by a simple cystotomy. The only safe rule is to look upon all these cases as bad risks, and to hedge them about with every known safeguard. They need them all, and in the better walks of life, they

need all the loving care and attention that their relatives can bestow upon them. Few surgeons will deny that in desperate cases the two-stage operation is the safer, but they will tell you that in good cases it is not necessary. And that is where the danger to the patient lies, that he will be taken for one of the "good" cases. And unfortunately some of those good cases, after a primary prostatectomy, turn out to be anything but good. Under these conditions what right have we to gamble about the patient's general condition? Bluntly expressed, that is what we do when we expose any old patient to the dangers of a prostatectomy at one sitting. Slowly but surely this fact is beginning to be recognized by surgeons in this country, and its fruitful seeds are beginning to sprout abroad.

We have no reliable statistics to compare the mortality of the one-stage and two-stage operations and we probably never will have. The cases vary too much, one man selects his cases and refuses to operate on desperate cases. Another man operates on all cases, whereas a third man reserves the two-stage operation for cases that he does not consider good risks. But we believe no fair-minded surgeon will gainsay that if we take one hundred consecutive cases and do the one-stage operation the mortality will be higher than if we take the same series of cases and do the two-stage operation. Why, then, does not every surgeon do the two-stage operation in every case, what are its supposed disadvantages? First and foremost, the lengthening of the time of healing. Those surgeons who limit the two-stage operation to infected cases naturally find that the convalescence is prolonged. If these men compare the healing time of these infected cases, done in two stages, with the healing time of their clean cases done at one sitting, there is naturally a considerable difference. The writer is able to testify to the correctness of this fact, as he himself for several years limited the two-stage operation to infected cases, and they did take longer to heal. But in uninfected cases the period of convalescence is but little lengthened. The suprapubic wound goes on granulating between the two stages, and the wound is finally healed almost as quickly as if the prostate had been removed at the first operation. But after all is the time of these old men so valuable that to save a few days, or even a week, we should endanger their lives? Second, the longer stay in bed. This objection falls away at once if we do not keep our cases in bed more than a day or two after either the first or the second stage of the operation. We encourage these cases not only to get out of bed early, but they are usually walking about the room on the third or fourth day after the cystotomy. In mild weather

we have these men sitting at the open window or going up on the roof between the two stages. It is surprising how much the general condition improves under this regime, and it is very gratifying to see how little shock there is in some of the most decrepit cases when it comes to the actual prostatectomy. Third, the danger of giving these old men ether twice is held up against the operation. This is a real objection if the surgeon finds it necessary to give ether twice. Personally I have never given ether or chloroform in any prostatectomy, whether done in one or two sittings. If done at one sitting, gas and oxygen are used, if done in two sittings the cystotomy is done under local anæsthesia, and the prostatectomy under gas and oxygen. We were the first to advocate doing prostatectomy without ether or chloroform twelve years ago, and we have never varied from this. The first stage can always be done almost painlessly under local anæsthesia. Many of these cases do not complain at all and in no case is it necessary to give even gas to open the bladder. And even the most difficult prostatectomy can be done under gas and oxygen. In a recent case the prostate almost filled a pint fruit jar, and yet it was removed under gas and oxygen. Fourth, the depressing mental effect on a patient of looking forward to a second operation. This is a real objection and must be overcome. Crile has shown that we should do everything possible to put the patient in the best condition to withstand shock, and we know from our work on the thyroid that fear increases post-operative morbidity as well as mortality. It is a very simple matter to remove this fear of a second operation. For years I have regularly lied to these cases, and told them that the prostate had been removed at the first sitting. When it comes time for the second stage I either tell them that a painful dressing must be done, or that I must put in a few stitches. Many of these old men did not know until long afterward that they had been deceived, and I have yet to meet a patient that resented such a deception. And it is really astonishing how little shock there is following the prostatectomy, many of these cases miss only one meal and are not much more shocked than they would be after a difficult dressing. We regularly find much more shock after the cystotomy than after the prostatectomy. And we are careful to wait until the patient is well over the shock of opening the bladder before removing the prostate. No fixed time is set for the second stage, it varies from a week upward, and we make it a rule not to remove the prostate until we feel that the general condition has improved as much as it will. In some cases we must proceed with the second stage before the general condition has become good. In the case of an old gentle-



man of seventy-eight, whom I operated on last summer, there were chills and temperatures up to  $105^{\circ}$  F before the bladder was opened. Following this there was some improvement in the general condition, but the temperature rose daily to  $102^{\circ}$  F. I waited ten days and then decided that we could not hope for any further improvement until the prostate had been removed. Two hours before the prostatectomy there was a slight chill with a temperature of  $103^{\circ}$  F. In spite of this I removed the prostate which contained a small, foul-smelling abscess. The temperature then soon became normal and the patient is now hale and hearty at seventy-nine.

Having now answered, as well as we could, the various objections that have been brought forward against the two-stage prostatectomy let us see what the dangers of prostatectomy in general are, and how they are met by the operation we advocate.

The chief dangers of prostatectomy in general are suppression of urine, secondary shock, general toxæmia and, especially in congested prostates, profuse hemorrhage. To these must be added the dangers of the anæsthetic and pulmonary complications. The mortality rate will bear a very close relation to the existence of one or more of these features in any given case. In cases of hydronephrosis due to the damming back of the urine, the preliminary cystotomy gives the kidneys a chance to recover their normal tone before the prostate is removed. I believe that a mild form of hydronephrosis is present in these cases much oftener than is generally supposed. And it is often very difficult if not impossible to ascertain this condition before operation. We firmly believe that some of the deaths are due to this unrecognized condition. Five years ago we did a two-stage operation on a patient of fifty-seven, but unfortunately only waited three days between the two stages. The man died a few days after the prostatectomy, without having given any signs of a kidney lesion or of any functional kidney impairment. We insisted on doing an autopsy and were surprised to find advanced bilateral hydronephrosis, there was very little renal parenchyma left. Usually such advanced hydronephrosis will cause singultus, and this should be looked upon as a very dangerous symptom, as these cases regularly die. It is true that they die even if no operation is done, but we believe that they should not be operated on unless the hydronephrosis can first be relieved to such an extent that the singultus disappears. In my fatal case I found out after the patient's death that he had been having attacks of singultus for several weeks before operation, but for some reason he kept this fact from me. But there are many mild forms of hydronephrosis that give rise to no

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symptoms and yet the kidney condition is a real menace to life, especially if the operation is done at one sitting. Regarding hemorrhage, I can truthfully say that since doing the two-stage operation this source of danger has been entirely eliminated. And it is often surprising to see how much shrinkage there is in an acutely inflamed prostate following the cystotomy. And does it not follow as a matter of course that there will be much less bleeding from a shrunken than from an acutely congested organ? And who will deny that there is more shock connected with the removal of an inflamed organ? And it is easy to see that the general toxæmia will be greater if the prostate is removed while the bladder is more or less infected, as it is in the majority of our cases. The large raw surface left after the removal of the prostate is capable of considerable absorption, and we can lessen this absorption, not only by clearing up the urine before removing the prostate, but also by allowing the prostate to shrink before removing it, not to point out once more that the better the general condition of the patient the less danger will there be from general toxæmia. And it is this general toxæmia that we personally dread most in these old men. During the interval between the two stages, the general condition regularly improves, sometimes to a remarkable extent. The temperature becomes normal, the pulse slower and more regular, and the appetite improves. Regarding shock it has been our experience that there is more shock from the cystotomy than from the prostatectomy. I have been frequently surprised at the amount of shock to these old men from a simple opening of the bladder under gas, or even under local anæsthesia. It often takes ten days for them to get over the shock of this trivial procedure. Is it any wonder then that we will sometimes find serious and even fatal shock following a primary prostatectomy? It has aptly been said that if the preliminary cystotomy kills, it would have been foolhardy to do a prostatectomy. As a matter of fact the cystotomy does not kill, the prostate becomes less congested, the cystitis subsides, the wound is lined by protective granulations, the general condition improves markedly, the danger of hemorrhage and infection is reduced to a minimum, and some cases that would have died are saved. Granted the wound takes a little longer to heal, which it does not even do in every case, is it not worth while? After all what are we trying to do, make a record for quick convalescence or save lives? That the ideal field for the two-stage operation is the emergency case, whether in the presence of hemorrhage or not there can be no doubt. But the surgeon who reserves the two-stage operation for the emergency cases does not give his patients the benefit of the safest pro-

cedure, and some of his cases that should recover unfortunately do not do so. The claim is sometimes made that with rapid operating the one-stage operation is no more dangerous than the two-stage. Nothing could be more fallacious than this form of argument. True it is, that a rapid one-stage operation will save some cases that would not survive a prolonged operation. But that is a long way from saying that even the most speedy one-stage operation will save some cases that we have saved and do save with the two-stage operation. The writer was one of the very first to point out the advantages of rapid operating in this class of cases, and in his papers on prostatectomy in 1904 and 1905 he insisted that the time of operation was an essential element in lowering operative mortality, and he altered his technic to save as many minutes as possible. And though it is true that our results improved as we were able to shorten the time of operation, yet even with the quickest possible operation the results were not as good as they now are with the two-stage operation. We can safely assert that no patient dies after the two-stage operation who would not have died after the primary prostatectomy. And we can state with even more assurance that a goodly number of patients, who would have died after the one-stage operation, are alive and well to-day because they had the benefits of the two-stage procedure. And is that not after all the crux of the whole problem? And as long as we have no way of determining before operation which of these old men stand shock well, and I wish to say with all possible emphasis that we have to-day no such method, the only safe thing to do is to assume that they all stand shock poorly and give them the benefit of the doubt by doing the safer operation. After twelve years' work in this field we are firmly convinced that we are doing the greatest good to the greatest number if we give up entirely the primary prostatectomy and give all of these old men the benefits of the two-stage operation.

# PRIMARY TUBERCULOSIS OF THE PROSTATE GLAND\*

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A CAREFUL search of the literature shows but two probable cases of primary tuberculosis of the prostate reported. This is most surprising, and in all probability does not represent a true percentage of the primary invasion of the gland by the tubercle bacillus, but a deplorable failure on the part of surgeons to have careful histologic examinations made of their specimens.

In spite of the many opinions offered, we must confess our ignorance that we do not actually know the mechanism by which the tubercle bacillus invades the genital organs. It is therefore difficult to say absolutely whether a seeming primary genital or urinary tuberculosis is or is not secondary to some other focus, possibly from caseated peribronchial or mesenteric lymph-nodes.

The accompanying statistics compiled from a monograph on prostatic tuberculosis are of interest.

Cornet<sup>1</sup> found in 10,000 deaths from tuberculosis other than pulmonary 1 per cent urogenital. Kapsammer found in 20,700 postmortems 1 per cent urogenital tuberculosis. Oppenheim found that in 37 deaths from genito-urinary tuberculosis 30 had pulmonary involvement. Reclus, 100 cases genito-urinary tuberculosis, 98 had lung involvement. Desnos, 16 cases prostatic tuberculosis, 6 had lung involvement. Julien, 41 cases of prostatic tuberculosis, 23 had lung involvement. Krzywicki, 14 cases of prostatic tuberculosis, 12 had lung involvement. Oppenheim, 100 cases of prostatic tuberculosis, 81 had lung involvement. Rautberd, 100 cases of prostatic tuberculosis, 85 had lung involvement. Fenwick, 157 cases genito-urinary tuberculosis, 3 per cent prostate alone involved (indefinite), 24 per cent prostate and epididymus involved, 3 per cent prostate and seminal vesicles involved, 6 per cent prostate and bladder involved. Davids, 360 cases of genito-urinary tuberculosis, none primary in prostate. Hess, 23 cases of genito-urinary tuberculosis, none primary in prostate. Barney and Cabot,<sup>2</sup> 101 cases of genito-urinary tuberculosis, 75 per cent prostate involved. Guisy,<sup>3</sup> 183 cases of genito-urinary tuberculosis, 10 involving prostate and vesicles alone, 5 prostate alone (records indefinite).

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\* Read at the Annual Meeting of the American Urological Association, Baltimore, April 1915.

<sup>1</sup> Hesse. *Tuberculose der Prostata*. Jena November 1913.

<sup>2</sup> Barney and Cabot. *J. A. M. A.*, December 6 1913.

<sup>3</sup> *Ann. d. Mal. des Org. Genito-Urinaire* 1906 vol. 1.

I am indebted to Dr Harry Jackson, Pathologist to the Cook County Hospital, for the clinical history and specimen of tuberculosis of the prostate with extension into the bladder (Figs 1, 2 and 3) The process in the prostate is evidently primary for the genito-urinary organs The patient entered the tuberculosis ward of the hospital on account of cough, loss of weight and general cachexia He did not complain of any urinary symptoms and, other than a notation that the external genitals were negative, there is no record of any physical examinations of his genito-urinary tract He died two months later Autopsy gave the following findings Acute disseminated miliary tuberculosis of all the lobes of the lungs, chronic ulcerative tuberculosis of the intestines, chronic nephritis, no evidence of any tuberculous process, marked fibrocaseous tuberculosis of the prostate tuberculous ulceration of the internal urethral orifice, bladder mucosa normal

The two cases found in the literature are as follows

CASE I<sup>4</sup>—Patient, aged seventy Diagnosis Prostatic hypertrophy Small nodules felt per rectum The other genito-urinary organs were normal, as far as could be determined Recovery complete in seven weeks

CASE II<sup>5</sup>—Primary prostatic tuberculosis All other genito-urinary organs healthy Perineal prostatectomy Patient died later from tuberculosis meningitis

The author's case (Figs 4 and 5), aged sixty-one, entered the genito-urinary service of the Michael Reese Hospital, giving the typical symptoms of prostatic obstruction, complete retention having occurred four days previously The only point of interest in the history is presence of a cough, which had been present for several years Physical examination of chest and abdomen was entirely negative Per rectum, the prostate felt about three times its normal size, consistency firm, surface smooth, except for two or three small nodules, which did not seem unusual Cystoscopic examination revealed nothing except a low grade of cystitis The median lobe protruded considerably into the bladder

Under local anæsthesia the bladder was opened and drained by Dr Kolischer, by whom, ten days later, the case was turned over to the writer for removal of the prostate The patient was in the hospital five months, on account of a persistent fistula, which was uninfluenced by gradually increasing doses of tuberculin subcutaneously This was started as soon as tuberculosis was reported by the pathologist It is of interest to note that there was not the slightest reaction to the tuberculin, even in one milligramme doses This is strongly suggestive that there was no other tuber-

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<sup>4</sup> Wulff Deut med Woch, 1909, p 1332

<sup>5</sup> Burckhardt Muench med Woch, 1911, p 1750



FIG 1—Autopsy specimen Bladder opened  
Ulceration around internal urethral orifice (1)



FIG 2—Autopsy specimen showing extensive involvement of the prostate & urethral orifice

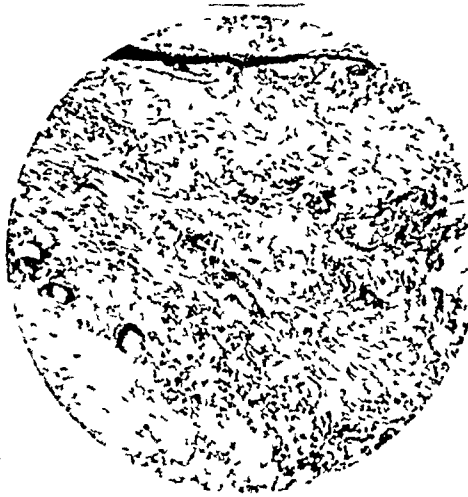


FIG 3—Autopsy case showing tubercle with giant-cells and caseation, also prostatic tubule with amyloid body



FIG 4—Autopsy case showing formation of caseation and some normal prostatic tubules

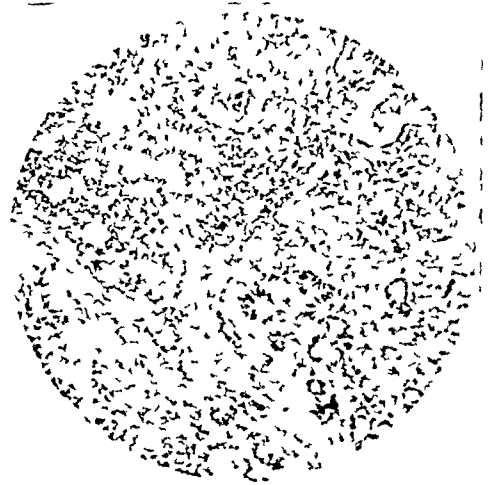


FIG 5—Autopsy case showing high degree of infiltration



## PRIMARY TUBERCULOSIS OF THE PROSTATE

culous focus in the body, at least active The patient finally left the hospital He underwent a subsequent operation for closure of the fistula, which has remained closed Unfortunately, I have not been permitted to make a cystoscopic examination, but the patient assures me that except for occasional frequency he is quite free from any urinary disturbance His urine contains considerable pus Per rectum there is nothing abnormal to be felt No tubercle bacilli can be found in the urine

The histologic findings by Dr Edwin Kirk, hospital pathologist, are as follows "Prostate gland about 6 cm long, 4.5 cm wide Both lateral lobes swollen, middle lobe enlarged Two or three wart-like excrescences on posterior aspect of one lateral lobe Gland feels hard, rather nodular Small whitish areas looking like caseated or necrotic areas Paraffin sections show typical tuberculosis of prostate with some caseation and considerable glandular hyperplasia, diffuse but local in distribution

"On tubercle stain, the tubercle bacilli are found in several of the caseated areas, the rod form, and in one area the streptothrix type"



# **PATHOLOGIC LESIONS OBSERVED IN THE POSTERIOR MALE URETHRA BY MEANS OF THE URETHROSCOPE\***

**AS SHOWN BY A SERIES OF PHOTOGRAPHS FROM WAX MODELS**

**BY ABR. L. WOLBARST, M.D.  
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WAX models have frequently been used to demonstrate pathologic as well as normal conditions in various parts of the human anatomy, but I have never seen any models of the lesions which we so often find in the deep male urethra with the aid of the modern urethrosopes. The models herewith exhibited (Figs 1-20) were begun in a modest way as an interesting and useful diversion, rather than with any other object in view. The results proved so satisfactory, that this method of perpetuating the appearance of the deep urethra has recently been applied to all cases presenting unusual or interesting conditions. By this means we are also enabled to make comparison of the conditions before and after the institution of local treatment.

The material used is the ordinary red modelling wax (plastiline) employed by sculptors. It may be said in passing, that colors in oil may be applied easily, thereby enhancing and preserving the beautiful views observed with the urethroscope. At the time of the examination of the patient, a rough pencil sketch of the lesion is made, and as soon thereafter as time permits, while the picture is still fresh in the mind's eye, the model is made, encased in a box specially made for this purpose. The box is of white wood, stained in any color desired, 5 inches long, 3 inches wide,  $1\frac{1}{2}$  inches high (Fig. A). The cover is of glass which slides in and out in a groove, so that, when the model is completed, the glass cover may be sealed in place by a strip of gummed cloth tape, thereby keeping out the dust and preventing handling of the model. From time to time, as the patient comes for treatment, any faults in the model may be corrected, making it more nearly perfect.

Photographs may be easily made, by removing the glass cover, the model, being solid, gives us a far more effective picture in three dimensions than any drawing or painting made by an artist, which must necessarily be flat. This makes reproduction of the lesion for publication much more striking than the flat drawing of the artist.

Apart from their value as above mentioned, these models may be employed to show the patient his particular lesion, both as to its location and character. In many of these cases involving the deep urethra,

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\* Presented before the American Urological Association, April 15, 1915

FIG A



FIG 1



FIG 2



FIG 3



FIG 12



FIG 13



FIG 14



FIG 15



FIG 16



FIG 17



FIG 18



FIG 19



FIG 20



the neurotic factor is well marked, and it is possible to relieve the mental distress and anxiety of some of these patients by demonstrating to them just where their ailment is and what the lesion looks like to the examining eye. As a result, patients are far more ready to accept the temporary annoyance and inconvenience of repeated urethroscopic applications than they would be otherwise. The effect is similar to that produced on patients by a radiograph. Moreover, they can be shown the progress which is being made in their individual case, by a comparison of the model made at the beginning of the treatment with that made at subsequent examinations. I consider this a decided help in securing the cooperation and sympathy of the patient, in the task of restoring his deep urethra as nearly as possible to the normal.

The instrument used in studying these cases is the McCarthy modification of the Buerger Cysto-urethroscope made by Wappler, of New York. The models represent, as nearly as possible, the views obtained by the aid of this instrument, both as to size and configuration. In every case, only the more striking features of the view have been represented, inasmuch as it is hoped that each model will have its own particular lesson to teach.

For the purpose of identification, the models have been numbered. Briefly they may be described as showing the following conditions:

- 1 Large veru, utricle and prostatic sinuses enormously dilated, posterior median ridge extending to the bladder neck. Clinically, premature ejaculation and partial impotence.

- 2 Normal pointed veru, multiple polypi or papillomata on the superior margin of the internal sphincter. Clinically, urinary frequency and tenesmus.

- 3 Large ulcer near the veru, which is much enlarged, small, healed ulcer at the anterior or proximal apex of the flattened veru. Clinically, very frequent and painful micturition, night and day. Tuberculous hip-joint and nodular prostate. Probably a tuberculous ulcer of the posterior urethra.

- 4 Veru distorted and hypertrophied beyond recognition, anterior surface is scalloped, while masses of tissue project from its sides and from its anterior and superior aspect. Clinically, urinary distress and sexual neuroses.

- 5 Veru moderately enlarged, prostatic sinuses enormously dilated, postmontane floor of urethra trabeculated and cut up into ruts of varying depths. Clinically, pain in perineum lasting fifteen years after an acute posterior gonorrhœa.

- 6 Same case as No. 5, after three months of treatment. The postmontane ruts are gradually disappearing, the mucosa is more nearly normal in color, and the sinuses on either side of the veru are becoming smaller. Clinically, patient feels much relieved of his pains.

- 7 Large veru, with tissue growth posteriorly, papillomata or polypi anteriorly and posteriorly. No clinical symptoms, except sterility and azoospermia.

- 8 Veru somewhat atrophied, moderate trabeculation of postmontane floor, a thick ridge anteriorly. Clinically, frequent nocturnal emissions for over ten years.

9 Veru enormously hypertrophied, with tissue masses resembling horns projecting into the urethra, utricle dilated Clinically, recurrent chronic gonorrhœal urethritis

10 Same case as preceding, after six months of treatment The "horns" have disappeared and the veru is resuming its normal size and shape. The anterior ridge leading to the veru has not responded to the local applications Clinically, much improvement in patient's condition

11 Enlarged veru, and covered with cystic bodies which were punctured and cut out with the operating scissors and punch Clinically, negative except azoospermia

12 Large deformed veru, with thick ridge on postmontane floor Clinically, chronic recurrent gonorrhœal urethritis

13 Veru very large, utricle enormously dilated, postmontane floor cut up into deep ruts extending to the vesical neck, cystic bodies on right posterior urethral wall, large mass of tissue projecting from right side of veru near the urethral floor Clinically, chronic gonorrhœa

14 Same as preceding, after four months of treatment Marked improvement visually and clinically

15 Veru elongated, resembling a human finger Clinically, urinary frequency and partial impotence

16 Same case as preceding after seven months of treatment Veru is resuming its normal outline, though still enlarged Clinically, urinary symptoms relieved, but impotence unchanged

17 Posterior urethra, after prostatectomy, showing deep groove taking place of prostate and veru, and demonstrating filiform emanating from the torn common ejaculatory duct Strangely enough, the operator evidently overlooked the large papilloma on the base of the bladder and the cystic bodies attached to the internal sphincter Clinically, frequent and painful urination, with cystitis

18 Unusually large and deformed veru, scalloped, and elevated above the urethral floor, thick anterior ridge Clinically, sexual neuroses following chronic gonorrhœa, also obstruction to urinary stream

19 Same case as preceding after five months of treatment Marked improvement as to size and shape of veru, and also clinically

20 Veru quite normal, flat type, unhealed ulcer anteriorly and on the same side posteriorly, a well-marked tearing of the postmontane floor, evidently a false passage made by faulty instrumentation Patient had been treated for a long time with sounds, occasionally causing severe pain and bleeding Clinically, chronic gonorrhœa with frequent exacerbations

If any comment might be made after a careful study of these models, one might confess to being struck by the fact that the clinical phenomena are often inversely out of all proportion to the serious pathologic changes, and, conversely, that slight lesions in the deep urethra often produce marked clinical phenomena of divergent character and great obstinacy It is also apparent that the modern posterior urethroscope has revealed a wealth of urethral pathology which was hitherto undreamed of One often wonders how these lesions were ever cured, without the aid of this instrument

# A MODE FOR VENTROFIXATION OF THE UTERUS FOR THE RELIEF OF PROLAPSUS

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ATTENTION is invited to a method of coelohysteropexy, which has for some years past been adopted by the author in the treatment of uterine prolapse, and in cases of retroflexion with symptoms

During the past twenty years various methods have been tried but none have been found as effective as the one below described, due possibly to the fact that it conforms with anatomical principles "The position occupied by the uterus in the pelvis is not always the same, as it varies to some extent with the condition of neighboring organs, the lower cervical part is, however, much more firmly fixed in place than the body and fundus, which possess a considerable amount of mobility" (Cunningham)

In the writer's opinion the dominant factor in uterine prolapse is the relaxation of the cervical attachments, and any operation worthy of the name should therefore aim at fixation of the cervix. Cunningham further states that, "The muscular coat of the cervix contains more connective and elastic tissue than that of the body, and hence the greater firmness and rigidity of the cervical part of uterus" The operation described endeavors to restore the cervix to its positive position—the keystone of support of pelvic organs—by fixing it to the recti muscles in the following manner

The abdomen is opened by the usual low central incision and the uterus exposed, any coexisting adnexal disease or adhesions are dealt with, the uterus is then drawn well up into the wound, and a transverse incision is made through the uterine peritoneum, just above and parallel to the utero-vesical peritoneal reflection (corresponding to the preliminary utero-peritoneal incision in hysterectomy) (Fig 1) The peritoneum, with bladder, is reflected downward and forward until a space of about one inch square is left denuded on the anterior surface of the cervix. The uterine peritoneum on each side of exposed area is retracted and three strong (11 day) catgut sutures are passed about one-third inch apart, through the exposed portion of the cervix, and sufficiently deep to obtain a firm grip of the cervical muscular coat (Fig 2) The ends of the sutures are drawn out on each side, respectively, through the recti muscles by a Childs ligature forceps



Thus the peritoneum is excluded and the denuded surface of cervix is brought into direct apposition with the recti (Fig 3)

In order to avoid subsequent intestinal adhesions at the site of fixation, the parietal wound is closed by tier sutures, the first suture purposely including the uterine peritoneum well above the denuded area (Fig 3, A) In uncomplicated cases it is at maximum a fifteen minute operation In most of the cases of uterine prolapse the first step is dilatation and curettage if endometritis exists, if cervix is ulcerated or hypertrophied and elongated, the vaginal portion is excised, then an anterior or posterior (or both) colporrhaphy is done In many cases there is added coeliohysteropexy

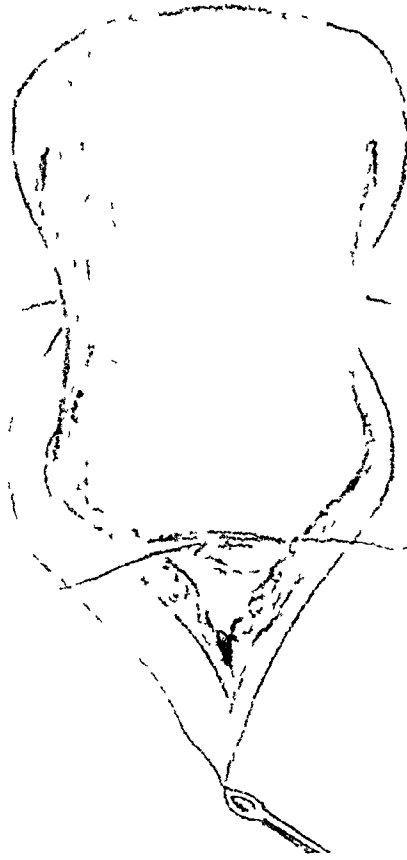


FIG. 1.—Uterus drawn out through central incision and transverse incision made through the peritoneum at vesico-uterine reflection

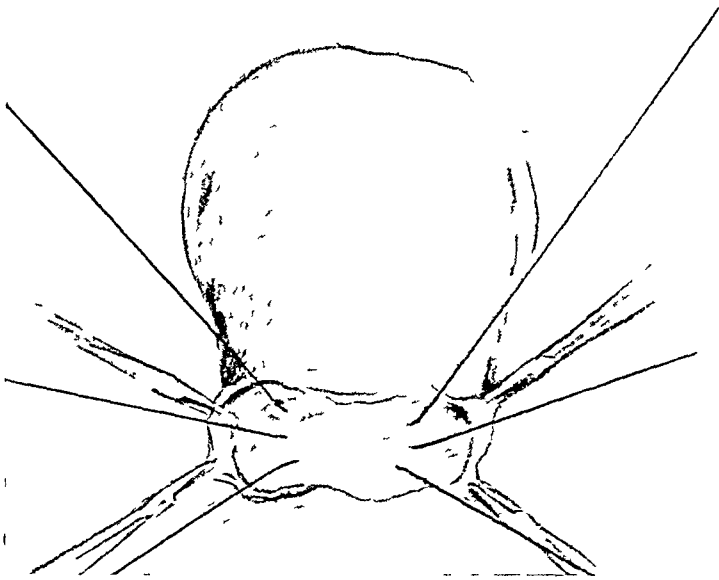


FIG 2 —Three cervical sutures inserted Uterine peritoneum retracted by forceps

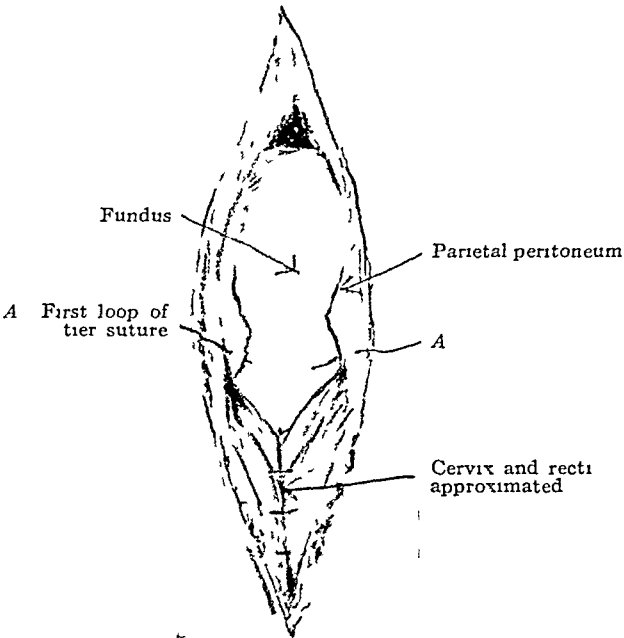


FIG 3 —The ventrofixation completed

# TENDON FIXATION IN INFANTILE PARALYSIS\*

OBSERVATIONS BASED ON ONE HUNDRED OPERATIONS

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A PRELIMINARY report of the procedure described in this paper appeared in the *ANNALS OF SURGERY*, March, 1913, describing the technic and the immediate results of six operations performed during the previous year. Sufficient time has now elapsed to warrant the expression of an opinion on the character and permanence of these results and on the value of the method in its general application to paralytic deformities. Since the publication of the preliminary reports, it has been brought to the notice of the writer that a similar principle has been tried by others, notably, Tilanus<sup>1</sup> of Amsterdam, Sangiorgi<sup>2</sup> of Bologna, and Reiner<sup>3</sup> of Vienna. The technic employed by these operators differs considerably from that described by the writer, but the general principle of the conversion of the tendons of paralyzed muscles into ligaments is the central idea of all.

Only minor changes have been made in the technic from that previously described. It consists of drawing the tendon of the paralyzed muscle taut and burying it in the bone in such a way that, after firm healing has occurred, the tendon prevents the part returning to its former position of deformity (Fig 1).

Naturally many questions presented themselves as to the probable outcome of such a procedure, which could only be answered by the lapse of time. First, could the tendon be expected to unite sufficiently solidly to the bone to prevent the strain of opposing muscles or of the patient's weight from pulling it loose? Second, would the tendon stretch under this strain? Third, if the patient is a child, would the tendon grow at the same rate as the rest of the limb and so avoid allowing a recurrence of the deformity or the production of a new deformity in the reverse direction?

After the lapse of three years we are now in a position to answer

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\* Read before the Academy of Medicine, Toronto

<sup>1</sup> Ned Tijdschrift voor Geneeskunde, 1898, 11, No 23

<sup>2</sup> Revista de Ortopedia, 1901, No 1

<sup>3</sup> Zeitschrift für Orthopädische Chirurgie, 1903, No 2

these questions First, the tendon will unite solidly to the bone and no strain to which any of the patients are normally subjected will be sufficient to loosen it Second, tendons do not stretch Third, the rate of growth of the tendon between its point of artificial fixation and its point of insertion, as demonstrated in young children whose limbs have doubled in size in three years, is practically at the same rate as the growth in the rest of the limb It may be necessary to modify this statement as time goes on, but in the meantime our anxiety on this point is much reduced

The simplest type of deformity to which the method is applicable is that of varus, which results from paralysis of the peronei (Fig 2) After the application of a tourniquet, a curved incision is made over the external malleolus, exposing the peronei tendons The tendon sheaths are split and the tendons are freed of all attachment to the sheath A vertical incision is then made through the periosteum on the outer aspect of the lower end of the fibula, towards the anterior border, extending upward about two and a half inches from the extreme tip of the bone With a periosteal elevator the periosteum is raised for an eighth of an inch or more on either side of the incision, and, in the case of the epiphysis and epiphyseal cartilage, the perichondrium and a flake of cartilage are raised with a knife With a gouge of suitable size a trough is then cut in the bone and cartilage, extending the full length of the periosteal and perichondrial incisions, and of sufficient depth to allow of one of the tendons being completely buried in it The varus deformity having been corrected, forcible manipulation being employed if necessary, the tendon of the peroneus longus is laid in the trough and drawn taut by an assistant, who holds the foot in a correct position with one hand and tightens the tendon with the assistance of a pair of Kocher clamps with the other The surgeon then passes a medium-sized kangaroo tendon suture twice through the tendon and through the cartilage on either side of the groove, at the lower end of the incision, and by tying the suture over the tendon, firmly fastens the latter in position When this suture has been tied, the surgeon's assistant should gently let go his grip on the foot, and thus test the solidity of the fixation If the position is not correct the suture should be readjusted The periosteum is then sewn over the tendon as it lies in its groove, with No 1 catgut A similar groove is prepared for the peroneus brevis tendon on the posterior surface of the fibula, exactly subjacent to the normal position of the tendon, and a similar operation is performed The reason for making one groove anteriorly and the other posteriorly in this operation is that by this means the two tendons balance one

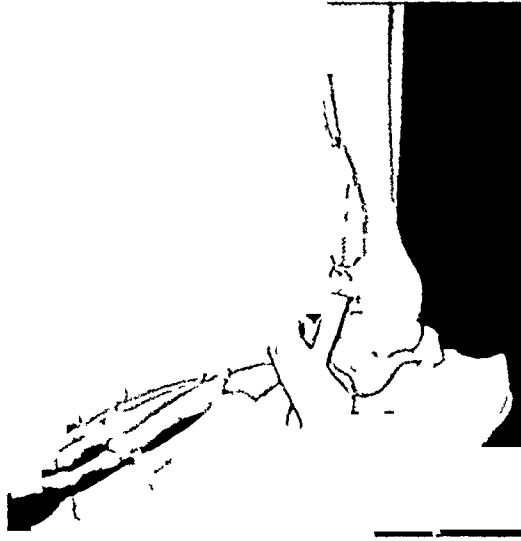


FIG. 1.—All the structures have been removed from the skeleton except the tibialis anticus muscle and its tendon and part of the annular ligament. The tendon has been buried in the tibia with a view to preventing foot drop. The kangaroo tendon anchoring stitch and the catgut stitch in the periosteum are shown.

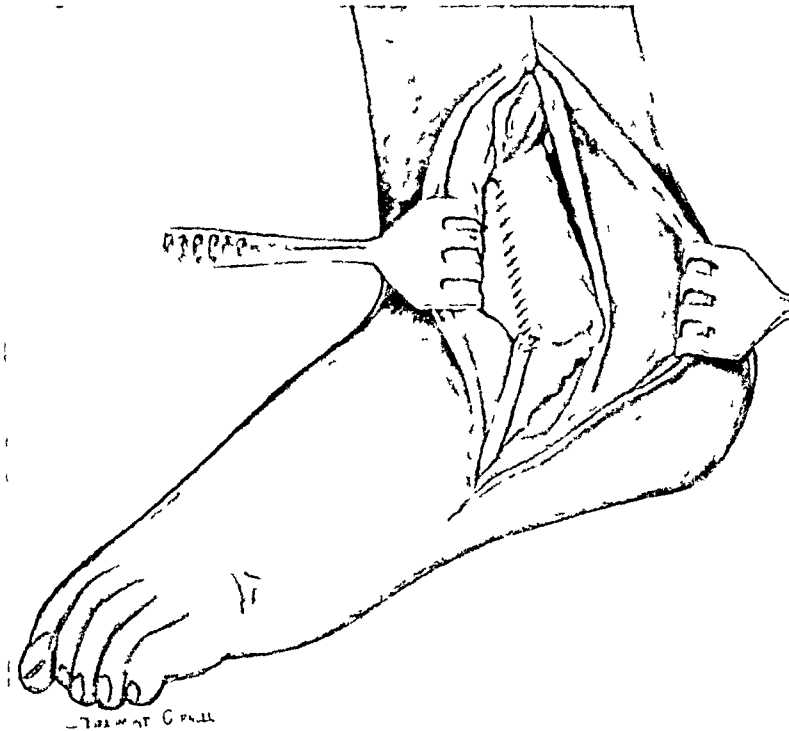


FIG. 2—The tendon of the peroneus longus has been fixed in the anterior border of the external malleolus and the tendon of the peroneus brevis is ready to be laid in the trough prepared for it behind the malleolus.



FIG 3—Photographs of casts of the same foot made before and after operation. The figure to the right shows deformity of equino varus. The figure to the left shows the same foot three months later after fixation of the peroneal tendons.



FIG 4—The tendo Achillis has been fixed in the posterior surface of the tibia to prevent the deformity of calcaneus. In addition the tendons of the peronei which are active have been transplanted into the os calcis. The flexor longus-hallucis and the posterior tibial vessels and nerves are indicated. The tibialis posticus muscle should also be seen.



FIG 5—Casts of a case of calcaneus made before and after operation. The tendo Achillis was buried in the back of the tibia as described. The figure to the right is a cast of both the patient's foot and the floor made in one piece and shows the foot supporting the full body weight. Note the free space under the heel indicating the efficiency of the fixation.



FIG 6—Casts of a case of valgus. The figure to the right shows the foot in the deformed attitude carrying the full body weight. The figure to the left shows the same foot after fixation of the tibialis anticus and posticus tendons. In each case the foot and pedestal are cast in one piece.



FIG 7 —Diagram of operation for partial paralysis of triceps suræ The tendo Achillis has been split and the anterior half cut free from the muscle and pulled through a small hole in the anterior wall of the sheath This part of the tendon has then been buried in the tibia The sheath has been sewn over the rest of the tendon with fine catgut The peronei which are active have been transplanted into the os calcis



FIG 8 —Casts of a case of calcaneo valgus resulting from partial paralysis of the triceps suræ The figure to the left shows the foot before operation The figure to the right shows the foot after tendon lengthening was performed on the tibialis anticus tendon fixation of half of the tendo Achillis, as described and fixation of the tibialis posticus to prevent the valgus The cast was taken with the patient standing, and the space under the heel shows the strength of the fixation





another. If both peronei were drawn taut in their normal position behind the malleolus, the result would be plantar flexion or equinus, in addition to abduction, but by placing one tendon in front and one behind, equinus deformity is prevented. The skin incision is closed with catgut and horse-hair, and a plaster bandage is applied extending from the toes to the knee. After six weeks the patient is allowed to walk and two weeks later the plaster is removed. Possibly a shorter fixation period would be sufficient, but as yet this has not been determined.

The results of this operation have been most gratifying. The patient is able to walk without splints of any kind and, if the peronei are the only muscles in the limb which are affected, he walks without limp. Fortunately the elimination of the possibility of adducting the foot is of no disadvantage to the patient in walking and running, and consequently many of these patients are practically completely cured (Fig. 3).

Another simple deformity to which this method of treatment is applicable is that of calcaneus, which results from paralysis of the triceps suræ muscle. With the patient lying face downward an incision is made along the whole length of the outer side of the tendo Achillis (Fig. 4). The sheath is split throughout the length of the incision and the tendon exposed. It is thoroughly freed from its attachments to the sheath and retracted inward so as to expose the fibrous covering of the deep muscles of the leg. A vertical incision is made through this sheath (which is the intermuscular septum between the deep and superficial layers of the flexor muscles of the leg) and the flexor longus hallucis comes into view. This muscle is then retracted inward, exposing the posterior surface of the shaft and lower extremity of the tibia. It may be necessary to divide a few of its fibres of origin from the fibula and interosseous membrane in order that sufficient length of the tibia may be exposed. A vertical incision is then made through periosteum in the middle line of the posterior surface of the tibia and the periosteum raised as in the peroneal operation. With a large gouge a trough is cut in the tibia, from two to two and a half inches long, extending into the medullary cavity. This trough usually extends across the epiphyseal cartilage and slightly into the epiphysis. The tendo Achillis is then buried in the trough in exactly the same way as in the peroneal operation. If the patient has a short leg the tendon may be fastened in such a way as to produce a slight fixed equinus, and if not, the range of dorsiflexion is locked at about a right angle. The incision is closed with catgut and horse-hair, and a plaster bandage applied.

The results of this operation up to the present have been excellent. Before operation the patient walks only on the heel. The arch is much exaggerated and, because of the patient's inability to support weight on the forepart of the foot, his gait is most ungainly. Practically all these patients keep the knee stiff in walking and so add to the degree of limping. Within a short time after the removal of the dressings a great improvement in gait develops. The patient now walks naturally, using both heel and toe, and bends the knee properly with each step. Within a month the exaggeration of the arch disappears or shows marked improvement, and on superficial examination the foot may appear normal. Closer examination of course shows the absence of the natural spring to the step which indicates active calf muscles (Fig 5).

In addition to the simple operations described for varus and calcaneus, the method is equally applicable to the various deformities that result from paralysis of the triceps suræ and of the tibialis posticus muscles. Here, in addition to a fixation of the tendo Achillis, one does a fixation of the tibialis posticus tendon into that portion of the tibia subjacent to its own groove. It has been our custom to give these patients the additional support of a flat-foot brace.

Similarly, paralytic equinus is treated by fixation of the tibialis anticus, equino-varus, by fixation of the tibialis anticus and of the peronei, valgus, by fixation of the tibialis posticus, and equino-valgus, by fixation of the tibialis anticus and tibialis posticus (Fig 6).

There are, however, some important modifications of the technic which deserve consideration. In the first 75 operations the muscles whose tendons were fixed had been completely paralyzed for more than two years. But cases were occasionally presenting themselves in which deformities were present in spite of a partial recovery of the muscle. Obviously it would not be wise to do a tendon fixation in such cases and yet the deformity calls as urgently for treatment here as in the cases of complete paralysis. To combat such conditions the experiment was tried of doing a fixation of half of the tendon and leaving the other half free to carry out the function of the normal tendon. The operation was first tried on a case of calcaneus in which about one-quarter of the normal power was present in the triceps suræ. This case was reported in the *ANNALS OF SURGERY*, January, 1915. The preliminary details of the operation are the same as already described for calcaneus. When the tendon has been exposed it is split longitudinally into an anterior and a posterior half and at the upper end of the incision in the tendon the anterior half is cut free from the muscle. This piece of tendon is then threaded through a small hole in the an-

## TENDON FIXATION IN INFANTILE PARALYSIS

terior wall of the sheath and fixed in a groove in the bone as above described, locking the foot at a right angle. Finally, the sheath of the tendo Achillis is sewn over the other half of the tendon with fine catgut and the wound closed as usual (Fig 7)

Six cases have been treated in this manner with excellent results. Not only do the patients have a permanent locking of the foot at a right angle when the foot is dorsiflexed, but they are able to plantarflex the foot voluntarily to the normal range. This enables them to walk with a certain amount of spring to the gait as the weight leaves the ball of the foot. The half of the tendon which was left attached to the muscle increases to the normal thickness (Fig 8)

This principle has also been employed in cases of varus in which there is partial power in the peronei muscles, and the results are equally gratifying.

In relation to these cases of partial paralysis an interesting observation has been made. After the patient begins to walk again there is a rapid improvement in the power of the partially paralyzed muscle and in a few weeks the power will be much greater than before the operation. This is probably accounted for by the elimination of the constant overstretching of the weak muscle. It now gets plenty of exercise without ever being overstretched, and consequently increases in size and power. This explanation is based on Robert Jones' observation that the paralyzed muscles recover more rapidly and more fully if overstretching is prevented.

Frequently other operations may be combined advantageously with "tendon fixation." Thus in calcaneo-valgus a favorite operation is that described by Nicoladoni, namely, transplantation of the peronei tendons, when these muscles are active, into the os calcis. This has been combined with fixation of the tendo Achillis on many occasions and works satisfactorily (see Fig 4). Similarly, fixation of the tibialis anticus for equinus has been combined with transplantation of the extensor longus hallucis into the first metatarsal.

On several occasions also, in cases of severe equino-varus, fixation of the peronei has been combined with excision of bone from the outer side of the foot and arthrodesis of the midtarsal joint. The combination seems to be successful.

Recently an opportunity occurred to obtain a section of a fibula in which a tendon fixation of one of the peronei had been done a year before. Sections have been made transversely and longitudinally through the tendon as it lies in its groove. The microscopic appearances show the tendon united intimately to the subjacent bone by

short bands of fibrous tissue. These fibres run around and through the tendon and are very intimately attached to the bone. The bone is irregular in outline, presenting many minute openings under the tendon. Into these openings the strands of fibrous tissue run, sometimes ending in the bone and sometimes emerging from neighboring openings to lose themselves again in the tendon. In some places the fibres can be traced into the bone, and in others the dividing line between bone and fibrous tissue is quite indefinite, owing to the intimate mixture of the two. The periosteum over the tendon is solidly united to it and it is interesting to note that there is no sign of new bone formation between the tendon and periosteum.

Since the publication of the first communication on this subject, approximately 100 operations have been performed. All have healed by primary union and all except two have been decidedly improved. The first of these two cases was a complete failure, the deformity of varus recurring immediately after the child was allowed to walk. The operation was repeated and it was found that in planting the tendon in its groove its sheath was buried with it and as a result the groove in the bone was lined with synovial membrane and consequently no fixation occurred. Since this failure we have been careful to scarify the tendons before burying them. The second case was a failure simply because the foot was allowed to change its position after the sutures had been inserted and the tendon was drawn loose from its groove. It is well to remember that after the plaster is removed the foot will remain where the tendons held it before the plaster was applied, that is to say, the result depends directly upon the perfection of the technic.

With an experience extending over a period of three years and derived from the application of this method to over one hundred cases, the writer now feels himself in a position to recommend this operative procedure. The chief point in its favor is its efficiency in preventing recurrence of the deformity. This is accomplished in a manner so closely resembling the normal that mobility of the limb is preserved in all directions except the one in which it is wished to prevent motion. It has thus an advantage over arthrodesis. It is equally applicable to all ages, the same success attending operations on patients of four years of age as on adults. The more recent development of using one-half of a tendon for fixation, in cases of deformities accompanying paralysis from which partial recovery has occurred, greatly widens the field of its usefulness, and in the practice of the writer has practically eliminated the operation of silk ligament installation. In cases of severe calcaneo-valgus and danglefoot, it undoubtedly compares unfavorably

## TENDON FIXATION IN INFANTILE PARALYSIS

with astragalectomy as suggested by Whitman, but in the more moderate cases, such as those shown in the illustrations, it has the advantage of preserving the length of the limb and avoiding additional deformity

The only element of doubt as to the permanence of the results arises from the question of growth, as pointed out above, and naturally, many years must pass before an absolute statement can be given. From present indications, however, it seems likely that the rate of growth of the tendon and of the rest of the limb will continue in the same ratio, so that we no longer hesitate to apply the method to whatever suitable cases present themselves for treatment

# CORRECTIVE OTOPLASTY \*

A REPORT OF TWO CASES

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OTOPLASTY, or the correction by operation of abnormalities in size, shape and position, congenital or due to injury, of the auricle, being, as a rule, without functional benefit, may be truly termed cosmetic surgery. We should not assume, however, that the indication for such an operation is entirely based upon the desire of the patient to be "better looking," for in some instances the improvement in facial configuration is of economic importance to the individual, who is undoubtedly handicapped by an unprepossessing appearance.

The two cases which I wish to report were operated on within a few weeks of each other. The first patient was a man of twenty-seven years of age, the second patient a boy of nine. The deformities were congenital in both instances, consisting of a malposition only in the case of the man, and of a malposition and malformation in the boy. The first case was, by far, the simpler of the two, and by following a modification of the method of Kolle a most excellent result was obtained. The second case presented specific difficulties, as most plastic procedures must, the outcome, however, is very satisfactory.

Preliminary to a description of the cases in point we should consider briefly what constitutes a normal ear in size, shape and position, and the structural framework of the auricle, for before attempting to remedy a deformity we must have a definite standard for comparative purposes and must also understand the nature of the tissues on which the success of the operation depends. Blake and Reik<sup>1</sup> give the following description of a standard normal ear. "It should be, approximately, twice as long as it is broad, and its relation of attachment to the head should form an angle of not less than fifteen and not more than thirty degrees therewith. It should have a well-defined helix, separated from the antihelix by a distinct scaphoid fossa extending down nearly to the level of the antitragus. The root of the helix should

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\* Read before the Baltimore City Medical Society, December 18, 1914

<sup>1</sup> Blake-Reik. Surgical Pathology and Treatment of Diseases of the Ear

be lost in the concha before reaching the antihelix, which should not be unduly prominent and should have a well-marked bifurcation at its superextremity. The lobule ought to be shapely and not adherent to the cheek along its anterior border nor yet too pendulous."

The structure of the auricle, it will be remembered, is mainly a plate of yellow fibrocartilage from one to three millimetres thick, folded in various convolutions. The skin covering the cartilage is thin and closely adherent, especially on the concave aspect. The muscles and ligaments are rudimentary and of but minor importance. It will be obvious that variations from the normal in shape and position of the auricle must be due to abnormalities in the shape and position of the cartilaginous framework, and the remodelling of this skeletal tissue becomes, therefore, the most important step in the operation. Even in a simple case of protruding ears, the normal elasticity of the cartilage would soon overcome what effect might be gained by the removal only of an area of skin, on the other hand, an excessive removal of cartilage would mar the symmetry of the anterior convolutions. It should be decided beforehand, then, just what portion of the cartilage should be removed and what portion may be bent into shape the more nearly to conform to the standard ear.

The preparation of the field of operation should be the same as for any major surgical procedure. The hair should be shaved over an area of two inches above and behind the ear. The patient should receive a general anæsthetic. It should be needless to say that the strictest asepsis is imperative.

The instruments required are, a sharp medium-sized scalpel, mosquito artery clamps, medium-sized dissection scissors, and tissue forceps. For the cartilage I found the Freer submucous cartilage knife and the sharp and dull elevators used in nasal surgery most excellent. Number 0 catgut should be used for the buried sutures and fine black silk for the skin sutures.

Mr J D, twenty-seven years of age, was referred to me by Dr L B Whitham, July 7, 1914, complaining of "protruding ears." The condition was congenital and had always been a sore point with the patient, who for some years had experimented with various bandages and head-gear designed to overcome such defects. Examination showed that the ears, though large, were well shaped, but that the attachment to the head was at an angle of  $70^{\circ}$ , an angle at least  $40^{\circ}$  too great. This malposition was due to an excessively curved conchal cartilage, the other convolutions being normal. The upper part of the ears flared with a slight



droop downward and forward. The lobules were normal. The object of an operation, in this case, was the correction of position only, and a modification of the method of Kolle<sup>2</sup> was adopted as best suited to meet the requirements.

Fig 1 is a diagrammatic representation of the procedure. The dotted lines indicate the skin incision as shown by Kolle, and the shaded area shows the portion of cartilage that he removes. The mechanical effect of denuding such a skin-area is readily understood, but without the removal of the section of cartilage the effect so gained would soon be overcome by the elasticity of this tissue. Therefore, the ear must be made to lie without tension.

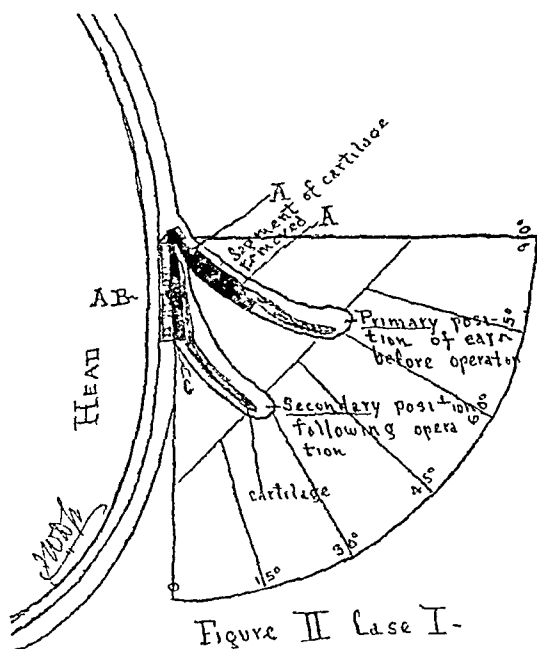


FIG 2 —Case I. AA suture in cartilage, 00 catgut, AB suture AA tied passed through periosteum and again tied thus anchoring ear in new position and preventing tension at line of skin sutures C.

in its new position, and this is effected by the removal of a segment of the cartilage. The heavy lines in Fig 1 indicate the modification of Kolle's incision which I found necessary to make in the case of Mr D, and the black area shows the portion of cartilage which I removed. I made this change, not only to meet the requirements of the individual case, but for the reason that in looking at the photographs of Dr Kolle's cases it seemed to me that the post-auricular sulcus was too shallow, and that to gain an effect nearest approaching the normal the larger portion of the heart-shaped denudation should be made upon the scalp, and not on the posterior surface of the auricle. The effect of this incision is not

<sup>2</sup> Kolle, F. S. Plastic and Cosmetic Surgery

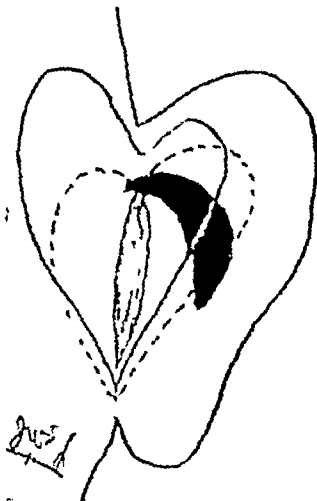


FIG 1—Case I. The dotted outline indicates Koller's skin incision the heavy line my modification for the case in point. The shaded area represents elliptical portion of cartilage removed by Koller, the black area, the cartilage removed in my case. The portion beyond the incision is taken out subcutaneously.



FIG 3—Case I. Result of operation. The outlines indicate the position of the auricles before operation.

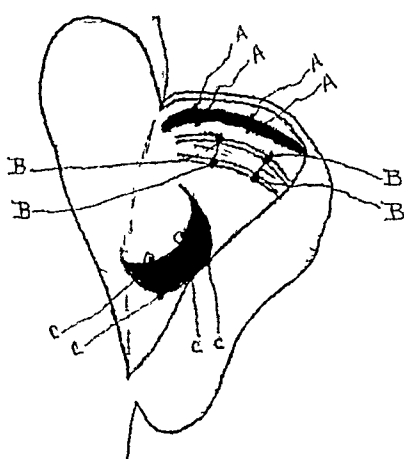


FIG 4 —Case II Outline of operative steps—  
right ear

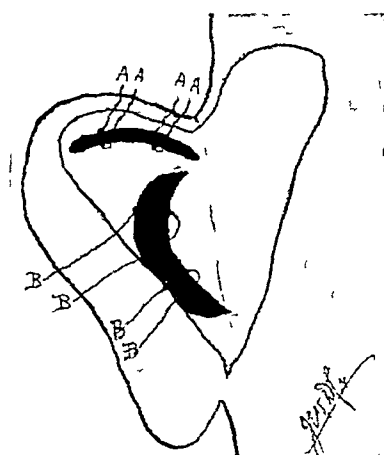


FIG 5 —Case II Outline of operative  
steps—left ear



FIG 6—Case II Condition of ears before operation



FIG 7—Case II Result obtained by operation



FIG 8—Case II Right ear



FIG 9—Case II Left ear



only to retract the ear, but also to elevate it, and this result was particularly needed in the case under discussion. The section of cartilage removed was taken from the upper and posterior portion of the conchal curve, as this was the portion of the cartilage at fault. It was removed in a semilunar form for the reason that the edges would the more easily fall into coaptation, than had the incision been elliptical, as shown by Kolle. Fig 2 schematically shows the mechanism of the operation and explains itself.

The steps of the operation were as follows. The area of skin to be removed was outlined with the knife down to the subcutaneous tissue and quickly removed with the scissors. All bleeding points were clamped and any vessel showing a tendency to continue bleeding was tied off. After the removal of the adipose tissue covering the cartilage, the semilunar segment to be removed was readily outlined with the Fierer knife, and separated without difficulty from the skin covering the anterior surface of the ear, by the aid of the sharp and dull elevators used in the submucous operation upon the nasal septum. A finger of the left hand was kept in the concave surface of the concha to avoid perforating the skin. All care was used to remove the segment of cartilage without undue trauma, and this was readily accomplished with the instruments mentioned.

That the anterior configurations of the convolutions may not be distorted it is well to remove the smallest segment of cartilage consistent with the result desired, which is that the ear should lie in its new position by its own weight and without tension. If this effect be unobtained after what seems to be the excision of sufficient cartilage, the cut edges may be brought together with No. 00 catgut, and this suture tied and passed down to and through the periosteum, thus acting as an anchor-stitch and holding the ear in its new position. In the case of Mr. D. this anchor-suture was not needed and was not used, though I have since reached the conclusion that it is a good plan in all cases, and shall hereafter always use it.

The ear having been placed in its new position and finding that it required no deep sutures and that the cut edges of the cartilage fell into coaptation, the skin was sutured with interrupted fine black silk sutures, silver foil applied, and over this a light gauze dressing. The bandage was carefully adjusted to give firm support without undue pressure.

The method employed was practically the same for both ears and both ears were operated on at the same sitting. The sutures were in part removed after four days, the remainder three days later. There was very little if any reaction from the cartilage wound and the skin healed with a hair-line scar. The bandage was

worn constantly for ten days, and at night for six weeks. The photograph<sup>3</sup> (Fig 3, Case I) taken six months after operation shows the result obtained. Particularly note that there is a normal postauricular sulcus, a good conchal curve, and that the angle of attachment to the head has been markedly decreased.

The second case was much more difficult than the one just described and presented certain features requiring a different operation for each ear.

F. S., age nine, was first seen at the Baltimore Eye, Ear and Throat Hospital five years ago, and an operation was advised at that time, but the patient did not return. In August, 1914, the parents consulted Dr. H. O. Reik, who kindly referred the patient to me for operation. Both ears were attached to the head at an angle of nearly 90° and both were malformed. The right ear was crumpled and drooping and lacked an antihelix. The antihelix of the left ear was too prominent. Both ears were of good size (see Fig 6, Case II).

Figs 7, 8 and 9 show the result two weeks after operation. It will be seen that I have made an antihelix in the right ear. In the left ear the incision through the antihelix slightly distorts the anterior configurations of the convolutions, but this could not be avoided. Both ears set too close to the head, this also, in such a case, could not be avoided. The lobule of the right is slightly drawn, later, under cocaine, this can be easily remedied.

The method of operating upon the right ear was as follows (see Fig 4). The area of denudation was made as shown in the drawing, the incision on the ear having to be carried to the extreme upper edge of the auricle. An elliptical section was then removed from the helix and the edges drawn together with No. 00 catgut (*AA*). Below and running parallel with this incision a fold was made in the cartilage and held with the sutures *BB*. A semilunar portion of cartilage was then removed from the concha and the edges drawn together with the sutures *CC*. The sutures *AB* and *C* were then passed down and through the periosteum, securely anchoring the ear in its new position. The skin was sutured with fine silk interrupted sutures.

The left ear was operated upon as shown in Fig 5. The skin denudation was practically the same. *AA* shows the section of cartilage removed from the helix, and *BB* the semilunar segment removed from the concha. The ear was anchored in its new position with sutures *A* and *B*. The convolutions were packed with gauze and a firm bandage applied.

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<sup>3</sup> The patient refused to have any photographs taken before the operation.

## CORRECTIVE OTOPLASTY

The patient was kept in bed twenty-four hours. The after-treatment was the same as described in the first case, and the result, so far as reaction was concerned, was as happy and unmarked by complications.

In conclusion may I say that whereas slight variations from the standard ear are the rule rather than the exception, such malformations as presented by the second case are not common, and certainly the correction of this deformity must prove a useful asset to the boy.



# TRANSACTIONS OF THE NEW YORK SURGICAL SOCIETY

*Stated Meeting, held April 28, 1915*

The President, DR. FREDERIC KAMMERER, in the Chair

## NEPHRECTOMY AND PARTIAL URETERECTOMY FOR TUBERCULOUS KIDNEY IN A CHILD

DR. EDWIN BEER presented a girl, ten years of age, who had suffered from *enuresis* since infancy. For the past four years she had had infrequent pains in right loin. For the past ten weeks, had had incontinence by day, wetting clothes and bed every few minutes. Of late, there had been a slight improvement in this respect, the patient wetting herself only a few times each day. She had lost weight and strength. Patient transferred from service of Dr. Koplik.

Examination of urine showed pus, albumin and tubercle bacilli. Cultures were sterile.

March 6, 1915, cystoscopy and ureter catheterization under anaesthesia. Bladder capacity small. As soon as 1 ounce was introduced, there was bleeding. About the right ureter there was considerable exudate and retraction. The left ureter appeared normal. The left kidney secretes deep blue (indigo carmine) stained urine in twenty minutes. Left kidney 24 per cent urea, hyaline and hyalo-granular casts. No tubercular blood-corpuscles found.

On March 9 a right nephrectomy was performed. The kidney appeared outwardly normal, but the ureter which was lifted into the wound showed well-marked thickening. The ureter was tied off three inches from the pelvis and the kidney removed.

March 13, 1915, already patient holds urine better.

March 20, 1915, no tubercle bacilli in urine.

March 21, 1915, incontinence during day has stopped.

March 23, 1915, no tubercle bacilli in urine.

March 24, 1915, no tubercle bacilli in urine.

March 26, 1915, patient discharged, with practically no more evidence of bladder irritability, as shown by incontinence and enuresis.

*Pathological Report*—Tuberculosis of kidney.

## HEPATOTOMY AND DRAINAGE OF LIVER ABSCESS

The interesting points in this case were 1 The youth of the patient, suffering from renal tuberculosis 2 The tuberculosis masquerading as enuresis in childhood 3 The rapid improvement of the patient after operation 4 The value of inspecting the ureter to see whether it is thickened, prior to nephrectomizing what looks outwardly like a normal kidney<sup>1</sup>

## HEPATOTOMY AND DRAINAGE OF LIVER ABSCESS

DR BEER presented a woman, twenty-four years of age, who was admitted to the service of Dr A Meyer, February 26, 1914 She had had no previous abdominal disease Six months prior to admission, after labor, bled once from hemorrhoids The history obtained February 19, 1914, was that the present trouble began with fever and general pains, four days later, chill and cough On admission there was jaundice, dulness at right base and distant bronchovesicular breathing, diminished voice and fremitus (septic pneumonia<sup>?</sup>) The jaundice became deeper, the liver grew larger, so that it could be felt four fingers below the ribs, and was tender anteriorly White blood-corpuscles 18,000-20,000, polymorphonuclears 84-88 per cent On March 3, there was some œdema in the superficial tissues in the epigastrium, distinct swelling behind the right upper rectus Temperature 102°-106°, pulse 100-130, respirations 24-40 Urine albumin ++, and granular casts Exploratory laparotomy was performed the same day, under local anæsthesia The liver (probably the left lobe) was exposed through upper right rectus incision As there were no adhesions the abscess was not opened, but protecting packings were placed in the wound exposing the liver in the centre of the incision Aspiration showed pus in liver On March 5 the liver was incised with Paquelin cautery, packings left in place, and at a depth of  $\frac{3}{4}$  inch a very large abscess was opened A large drainage tube was introduced (no anæsthesia) During the next twenty-four hours about 1000 c c of pus drained off The pus contained no amœbæ Cultures from the abscess were sterile (?) Blood cultures were negative The patient continued to run a septic temperature to 106.8°, with repeated chills Hypos of emetine did not control the situation March 20, liver aspirations were negative

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<sup>1</sup>Dr Beer said that on first seeing the apparently outwardly normal kidney he doubted the trustworthiness of the diagnosis although he had made the cystoscopy himself As in other cases of this sort, he exposed the ureter before taking out the kidney, and found corroborative evidence

During the next five weeks the jaundice gradually became less, and after the patient's transfer to the open-air (roof) ward there was a sudden marked change for the better. The discharge rapidly became less and the septic fever disappeared (probably the pus drained out through one of the large ducts). About six weeks after the original operation, the intraperitoneal packings were withdrawn, and on April 23, 1915, the patient was discharged well.

#### PAPILLOMATOSIS OF BLADDER CAUTERY EXCISION

DR BEER presented a patient in order to call attention to a method of treating these cases which is probably more efficacious than those formerly employed. The patient Dr Beer owes to the courtesy of Dr Lilienthal.

In 1906 the man had a suprapubic cystostomy performed for removal of papilloma.

March 3, 1915, cystoscopy revealed multiple recurrent papillomata. On March 10, an extirpation of the papillomata was performed by means of the Paquelin cautery. The bladder was exposed and freed. It was about the size of an orange, and was distended with the tumors. The perivesical tissues were thoroughly protected with packings, and then the bladder, which was drawn out of the abdomen, was incised and the papillomata cut away with hooked cautery, the bases being thoroughly charred. The entire interior of the bladder was carefully cauterized, the Paquelin being used for over one hour. Before closing the incision in the bladder, the edges were cauterized and then the wound was closed.

During convalescence, the patient developed facial erysipelas.

Patient was cystoscoped on April 12, and showed no sign of growth. The mucosa was pale pink, despite the extensive use of the cautery. There was no definite scarring of the mucosa. The patient has good control now and stands cystoscopy very well, and should any recurrence appear it can be easily burned off with the high frequency current. Some of the European surgeons recommend removal of the tumors by stripping off the mucous membrane from the muscle. Dr Beer said that he had tried that method, but the results were not very satisfactory and that he believed the method followed in this case to be the safer and surer way of eradicating the disease.

DR LILIENTHAL approved of the method of treatment employed, and agreed with Dr Beer that it should be generally used.

He then told of an almost parallel case, occurring in an older man,

## FOREIGN BODY IN LUNG

about six years ago The man's bladder filled with papillomata forming soft masses almost as large as hen's eggs Instead of operating as Dr Beer had done, he cut away what he could and used the Paquelin cautery on the base Now, after six years, the man has died of a condition which was probably carcinoma of the bladder Possibly further treatment by cautery might have saved him, but he lived in a small town many miles away and he had evidently become discouraged

### FOREIGN BODY IN THE LUNG REMOVED BY LOWER BRONCHOSCOPY

DR NATHAN W GREEN presented a boy, six years of age, who was admitted to the surgical service at St Luke's Hospital on December 16, 1914, special to Dr Downes, suffering from a cough and fever One month prior to his admission he began to cough, but was not ill enough to go to bed His cough continued and grew worse, and five days before admission he grew markedly worse He had lost weight and complained of pain in the right chest Upon admission, he gave the signs and symptoms of a right empyema, for which he was operated upon immediately As his condition did not clear up in the usual time, he was X-rayed by Dr LeWald and the presence of an upholstery tack in the region of the right terminal bronchus was discovered as the cause of the delayed convalescence Upon questioning the father more closely, it was recalled that the child swallowed a tack two years previously, but this had been forgotten He was turned over to Dr Green for bronchoscopic examination and for removal of the foreign body, if possible

The physical findings at that time were dulness over the right chest posteriorly from the angle of the scapula to the base, with diminished voice and breath sounds and numerous large moist râles An attempt was first made by means of an electromagnet introduced into the persisting sinus in the right chest to draw out the tack, but this failed Repeated bronchoscopic examinations through the larynx showed granulations at the end of the right bronchus with pus exuding The cavity which proved later to be surrounding the tack was not entered at this time A tracheotomy was performed on March 2, and seven days later the boy was bronchoscoped through the tracheotomy wound At this time the bronchoscope passed nearly to the cavity and forceps could be pushed into the cavity for two inches

It was considered that part of the tack at least must be made of iron and so a small electromagnet, which passed through the smallest size of bronchoscopic tube, was made, and this was introduced through

the tube 10 days later, under combined ether and cocaine anæsthesia. The tack was mobilized by this means and brought up into the end of the bronchoscopic tube with the head of the tack across lumen of the tube. An attempt to grasp it failed and the procedure was then at once repeated. This time it brought the point of the tack into the bronchoscopic tube. It was then grasped by special forceps through the tube and, resistance to its removal being felt, a steady traction was made upon it as the child breathed, and little by little the resistance was overcome and the bronchoscope, and the forceps through it grasping the tack, were removed simultaneously. There was some bleeding from the granulations. A suction tube was at once introduced to remove this, and in a moment the bleeding stopped.

The child since then has been steadily improving. The character of the expectoration which at first was fetid and green has changed to a white expectoration without odor. The amount of expectoration has diminished, as well as the amount of drainage through the chest. The child is gaining in flesh.

The interesting points in the case are that the foreign body has remained in the lung for two years and that there was no attempt at encapsulation. It lay in a cavity in the lung at the end of the right terminal bronchus and this cavity contained about an ounce of pus.

#### FOREIGN BODY REMOVED FROM THE LUNG BY POSTERIOR THORACOTOMY

DR GREEN presented a man twenty-four years of age, who was admitted to the medical service of St Luke's Hospital under Dr Austin W Hollis, suffering from cough and with a foul expectoration. Seven years ago he had a thoracotomy done in London for what appeared to be an empyema. The wound healed in five or six weeks and there has been no discharge since. The week previous to his admission he expectorated large amounts of foul-smelling pus, although coughing no more than usual. The sputum was greenish-yellow and there was never any blood in it. In short, he gave a clinical picture of a patient suffering from bronchiectasis.

On January 30, he was X-rayed by Dr Truesdale, and this picture showed the presence of a foreign body. On January 31 and on three later days, he was X-rayed by Dr L. T. Le Wald, who confirmed the diagnosis of a foreign body, and, by taking a picture at right angles, showed the true nature of the object, namely, that it was much the nature of a cotter pin. On going over the anamnesis, it was brought out that seven years before he had "swallowed" a badge fastener.

which he thinks he was holding in his mouth when a comrade slapped him on the back (The badge fastener was used to fasten the regimental badge to his uniform).

He was transferred to the surgical service March 20, 1915. Repeated attempts to find the foreign body were made by upper bronchoscopy, and, although the object could not be seen, in one of these attempts, the presence of a cavity was demonstrated, and in cooperation with Dr LeWald, the nearness of the end of the bronchoscope to the foreign body was shown. Later this helped to locate the pin by measurements and by the X-ray. On March 29 the bronchoscope was introduced and the magnet introduced through it, with the hope that the foreign body might be of iron, then the X-ray picture was taken. This showed the magnet to be within an inch of the foreign body, but there seemed to be no tendency to attract it. It was decided then that it would be better to go in through the back and remove it in this way.

On April 1, three shots were placed on the skin as a marker and a piece of half-inch-mesh wire netting. A radiograph picture was then taken by Dr LeWald in two directions. The distance of the foreign body was measured and found to be in one direction 6 cm. from the shot and lying just in front of the rib. On the same date, under local anaesthesia, two ribs were removed. The lung was found adherent to the parietal pleura as was expected, and found to have a hard spot in it. At the suggestion of Dr Martin this hard spot was entered with a needle and found to be the wall of a cavity. The needle was followed with a pair of dissecting scissors and upon opening them the cavity was widely opened. A pair of Blake's gall-stone forceps was then introduced into the cavity and the foreign body grasped and brought out. A tube was then placed into the lung and the wound was partially closed, leaving drainage.

The interesting points are that the X-ray located the badge fastener, repeated attempts to see the object through the bronchoscope failed, but the bronchoscopic method furnished the following information. That there was something causing granulations which filled up the right terminal bronchus. Second, that there was a cavity at the end of the right terminal bronchus,  $2\frac{1}{2}$  inches in length. (This was proved by passing a probe through this scope and feeling it "give" as it passed the opening of the cavity.) Therefore the foreign body probably lay loose in this cavity. Third, that the foreign body lay well toward the base of the lung and just anterior to the rib. Fourth, that the most of the cavity was rather behind the bronchus than just at the end of it.

The convalescence has been more rapid than in the case of the child

The character and odor and quantity of the sputum have changed markedly for the better, and the patient looks the picture of health

Of course, in both of these cases, one does not expect the cavity in which these foreign bodies have been lying, one for two years and the other for seven years, to heal up immediately. The after healing of them is a matter to be observed in the future.

DR LILIENTHAL said that it was his habit to have all empyemas X-rayed unless there was an absolutely clear history of the cause of the trouble such as an acute lobar pneumonia followed by empyema. He had seen a foreign body removed by bronchoscopy when the patient had been admitted for empyema. An X-ray picture was made and a foreign body was found which Dr Yankauer removed without any cutting operation. Since then, he had made it a rule to have all empyemas X-rayed when there was no clear history of the case. Not only that, but if there is much doubt, the case should be examined with the bronchoscope even if a foreign body is not suspected from the radiograph.

Another point in Dr Green's case is that the boy is apparently not yet well, even after this brilliant operation, the cause being perhaps a persistent bronchiectatic condition. Dr Lilienthal said that in one case at least he had demonstrated the interesting point that foreign body bronchiectasis might persist after the removal of the cause. Six or eight months ago he had showed before the Society a patient, a child, whose entire right lower lobe he had extirpated for an acute bronchiectatic condition which persisted after the removal of a foreign body. The child was losing rapidly and was septic, so the desperate operation of lobectomy was performed as nothing else promised any relief. Examination of the specimen showed suppurative bronchiectasis but no evidence of the foreign body.

The other case presented by Dr Green showed a very fortunate result and the patient would probably get well, even though there seems to be a rigid cavity which opens into the bronchus. The present condition is probably one of blind internal bronchial fistula.

Dr Lilienthal said that he wished to emphasize the fact that bronchial fistula can close without a plastic operation. He had had two cases which he feared would persist, but which finally did granulate and close up.

DR WALTON MARTIN said that he would not have expected either of these cases to show actual healing at this time. One was operated upon only a month ago and had been ill for two or three years previously.

## GELATINOUS CARCINOMA OF THE BLADDER

It would seem almost incredible that a person who had had an abscess of two years' standing should be well after two months

As to bronchial fistula closing he had had three or four close up after proper treatment, *i e*, good drainage established on the outside, and then repeated washing with watery solution of methylene blue, this sets up a violent coughing, which evacuates the fistulous tract and the bronchial abscess. Some of these cases had been shown before the Society three years ago

DR GREEN said that an interesting point in connection with these foreign body cases was the fact that when a foreign body is present it does not always cause a fatal bronchopneumonia, as used to be thought. One case, a boy who sucked a peanut into his lung, died two days later with bronchopneumonia. As Dr Lilienthal had said, all these cases ought to be X-rayed, but some foreign bodies cannot be discovered in that way. Both the little boy who "swallowed" the tack two years ago and the man who sucked in the cotter pin seven years ago had bronchopneumonia and then went through a long period of invalidism before the foreign body was recovered

## GELATINOUS CARCINOMA OF THE BLADDER

DR GREEN presented a man, forty-six years of age, who was referred to him by Dr. C Henderson, and was admitted to the surgical service of St. Luke's Hospital on April 23, 1914, suffering with a tumor, a little to the left of the median line, and "bladder trouble." Fourteen years before admission, bladder trouble started with pain, tenesmus and strangury. Diagnosis of vesical calculus was made at that time and external urethrotomy performed with but slight relief. For the last five months, prior to admission, tenesmus and strangury with frequency of micturition had been marked, with twenty pounds loss of weight in the year. One year before admission the tumor began to form. He denied lues and has twice had a Neisser infection

Upon physical examination of the abdomen just above and extending to the left of the symphysis, but not connected with the skin nor the muscles, was a hard, firm, rounded tumor, about the size of an orange, slightly tender, which appeared connected with the fundus of the bladder

Cystoscopic examination was made by Dr H G Bugbee, April 24, 1914. He reported that the patient voided freely. Urine contained pus and shreds. The prostate was moderately enlarged per rectum, boggy, irregular, and became firm under massage. The seminal ves-



cles were slightly enlarged and distended. The urine, after massage, contained a sediment of pus. A soft catheter did not pass through the membranous urethra owing to a stricture of long standing. A cystoscope passed with some difficulty. After irrigating the bladder it contained eight ounces of fluid which caused some discomfort. The mucous membrane of the bladder was slightly cedematous and markedly so in the region of the vesical neck. There were many flakes of mucus and pus loosely attached to the surface. The prostate was moderately enlarged intravesically, but not enough to cause an obstruction of the vesical neck. The ureteral orifices were normal. The urine coming from either kidney was clear. The mass palpable above the symphysis pubis was apparently connected with the bladder, but no intravesical communication could be detected. Bladder irrigations and instillations of the urethra were given until May 22, 1914, when another cystoscopic examination was made.

At this time the bladder retained eight ounces of fluid without discomfort. The mucous membrane of the bladder was slightly pale but otherwise normal, and at the top of the fundus of the bladder, in the median line, a small orifice (3 mm in diameter) could be seen. From this orifice a gelatinous substance exuded into the bladder. The bladder was filled with a solution of collargol and the radiograph showed a regular outline of the bladder wall, no fluid passing through the above opening.

*Operative Procedure*—May 26, 1914, a midline incision below umbilicus, and the tumor was exposed. The peritoneum was stripped from tumor but had to be widely opened in one spot in order to get it free. The tumor was removed, including the involved bladder wall, 2 inches in diameter. The bladder was sutured then, using three layers of fine chromic gut, and a large suprapubic rubber tube was inserted for drainage. The peritoneum was closed very carefully with catgut. The rest of the wound was partially closed with catgut and silkworm gut. Two small drains of rubber dam were inserted.

*Pathological Findings*—The tumor seemed to have originated from the upper wall of the urinary bladder, into which it had partially ruptured and was discharging its mucilaginous contents. The tumor itself was as large as an orange, rather nodular, definitely encapsulated, containing a soft, friable, gelatinous material. There was no attachment of the tumor to any other viscus than the bladder. The intestines, large and small, appeared absolutely normal.

*Pathological report* by Dr A. B. Eisenbrey, May 26, 1914

## GELATINOUS CARCINOMA OF THE BLADDER

Specimen consists of a tumor mass measuring  $12 \times 8 \times 7$  cm, removed from posterior wall of bladder. Mass showed a generally dense fibrous structure and considerable adipose tissue attached. One surface showed an area of bladder wall about 5 cm in diameter, with an irregular ulcerated surface, in which gelatinous material is present. The bladder wall is continuous with the main tumor mass, which on section consists of very dense fibrous tissue forming spaces filled with a gelatinous material. The central portion of the tumor is composed largely of this material.

*Microscopical Examination*—Sections from margin of ulcerated area in bladder wall show marked oedema, congestion, and round-cell infiltration and active invasion of the bladder wall and mucosa by a neoplasm composed of columnar epithelial cells, in a typical glandular arrangement. In many of the alveoli, the cells are of the mucous type and the alveoli are filled with a mucoid material.

Sections from main tumor mass show a very dense fibrous stroma forming small and large spaces filled with the mucoid material. Some of the spaces show epithelial structures, but in many the epithelium is entirely degenerated.

The neoplasm bears a close resemblance to the gelatinous carcinoma of the intestinal tract. Neoplasms of this type, however, are described as arising primarily in the bladder wall.

On April 14, 1915, patient was again examined by Dr. Bugbee. His report is as follows:

Patient emptied the bladder, urine contains a few shreds. Bladder retains eight ounces of fluid. Top of fundus of the bladder shows a smooth linear scar 3 cm in length. The mucous membrane of the bladder is normal with the exception of numerous elevations scattered throughout. These elevations are about the size of the head of a pin, hard and rounded. There were no nodules at the site of the scar.

The patient has gained fourteen pounds since leaving the hospital and is able to do his day's work. He has, however, some difficulty with his micturition such as was present for fourteen years previous to his operation. The patient was presented, on account of the interesting type of tumor which, as has been noted, bears a close resemblance to gelatinous carcinoma of the intestinal tract, but was primary in the fundus of the bladder.

DR. BEER said that primary adenocarcinoma was such a rare occurrence that he was somewhat inclined to doubt such a diagnosis. The prostate is the usual source of adenocarcinoma of the bladder, also metastasis from the intestines occurred in the bladder, and in view of the site of this tumor it was a question of whether it might not have risen from some of the structures about the umbilicus.

DR. GREEN said that the neoplasm bore a close resemblance to the gelatinous carcinoma often found in the intestine. As nearly as could

be determined, this was primary in the top of the bladder. It could not be called one originating in the urachus, and Dr Eisenbrey was unwilling to say that it bore any resemblance to such a growth.

INOPERABLE RECURRENT SPINDLE-CELLED SARCOMA OF THE SUPERIOR MAXILLA, DISAPPEARANCE UNDER TWO AND ONE-HALF MONTHS' TREATMENT WITH THE MIXED TOXINS OF ERYSIPELAS AND BACILLUS PRODIGIOSUS

DR WM B COLEY presented a man, forty-five years of age, who had been referred to him by Dr Joseph Bissell, on February 20, 1915.

Dr David L Satenstein, the patient's family physician, stated that the man came to him on April 18, 1913, at which time he had a very small tumor, the size of a cherry, situated between the bicuspid and first molar teeth, on the left upper jaw.

At the time of the patient's admission to Dr Coley's service at the General Memorial Hospital (February 20, 1915) he had a large radium burn on the left side of his face, about one inch in diameter. The skin was not broken, but was exceedingly red and tender. There was another larger burn, measuring  $1\frac{1}{2}$  inches in diameter, on the left side of his face, and still another a little below the first one. The left side of tongue was raw and very painful. He could open his mouth only three-quarters of an inch, and had a large and constant flow of saliva so that it was impossible for him to say more than a few words without wiping his mouth. Examination at this time showed a tumor of the upper jaw, extending backward as far as the furthest limits of the jaw, and reaching considerably below the alveolar process. It was too extensive for radical operation, and the patient's general condition was bad. He was put upon the mixed toxins (systemic injections given into the pectoral region) and the dose was carried up to seven minims. No other treatment was used. At the end of five weeks the larger portion of the tumor had become soft and necrotic, and under ether anæsthesia Dr Coley scooped out a large amount of completely and partly broken-down tumor tissue, there was considerable hemorrhage. After two or three days the drain was removed with further necrotic material, and the wound was carefully cleaned with permanganate of potash. A week later practically none of the tumor was left in the posterior and upper part of the superior maxilla, the only portion remaining being near the anterior part of the left superior maxilla, beginning at a level with the canine tooth, and extending backward about an inch, this was still firm. The toxins were continued every other day for

## INOPERABLE RECURRENT SPINDLE-CELLED SARCOMA

a month, at the end of which time the tumor has practically disappeared. The patient's general condition has markedly improved.

NOTES —In the course of his previous history it is recorded that several Wassermann reactions were tried and all were negative, although Dr. Satenstein says that 3 to 4 years ago, before the sarcoma developed, the patient had a positive Wassermann, and that he gave him several doses of salvarsan.

A section of the primary growth was removed shortly after its detection and on microscopical examination declared to be spindle-celled or fibro-osteosarcoma.

A second microscopical examination was made by Dr. Ewing, who reported giant-celled sarcoma. The material for this examination consisted only of the broken-down and almost completely necrotic tissue removed two months after the toxins were started.

Clinically, the tumor was a periosteal sarcoma, entirely unlike the giant-celled or epulis type of sarcoma.

Dr. Coley presented also a woman who had been operated upon by Dr. A. E. Isaacs, at the Beth Israel about eight years ago, for a very extensive intra-abdominal sarcoma.

The pelvis was cleaned out as well as possible, but a recurrence was seen to be inevitable as all the organs were involved in the adhesions. She made a prompt recovery from the operation, but leaving a fistula. X-ray treatment was begun, but caused such a dermatitis that the toxins were substituted, the toxins being administered by Dr. J. C. Reshower.

The microscopical examination report furnished him by Dr. Isaacs pronounced the disease "round-celled sarcoma with a few small spindle-cells."

At the time the toxin treatment was begun, the whole abdomen was apparently filled with an inoperable tumor. The prognosis was regarded as most unpromising. The toxins were begun on July 7, 1908, at which time the patient still had a fistula from the previous operation. The injections at first were given daily, then every other day, then twice a week, beginning with one-half minim, and increasing each time by  $\frac{1}{2}$  minim. The patient proved to be rather susceptible to the toxins,  $1\frac{1}{4}$  minims producing a severe chill, and temperature of  $103^{\circ}$ . She became more tolerant as the doses were increased, and by the beginning of April, 1909, had received sixty injections, the highest dose being 11 minims. During this period, the tumor in the abdomen apparently disappeared, and the patient has been in good health up to the present time.

Ever since the operation, the patient has had occasional slight swelling in the right foot and leg, with frequent pains. She was married two years ago, but has never been pregnant. Dr. Coley examined her, under ether, at the General Memorial Hospital a week ago, and with the exception of a small swelling about the size of a goose-egg (probably a cystic ovary) on the right side, nothing of a suspicious nature could be found. The patient is in excellent general health, seven years after the treatment was begun.

DR LILIENTHAL expressed a doubt as to whether the surgeons were using these toxins as frequently as they should. He had seen three cases of cure resulting from the use of Coley's serum, in which the diagnosis of sarcoma had been made. In all three cases only partial operations were possible, and much of the tumor was left *in situ*. In one instance the tumor disappeared, recurred, and again disappeared under the use of the toxins.

#### TUBERCULOUS PYONEPHROSIS

DR HOWARD LILIENTHAL presented a woman, twenty-eight years of age, who had been admitted to Mount Sinai Hospital on March 15, 1915, with a temperature of 101.2°, pulse 98, respirations 18. Five years before she had had a so-called cold abscess of the right flank which had been opened at Mount Sinai Hospital. This had healed completely. For about seven months prior to the present admission patient had had pain in her right side, sharp or dull, but continuous, frequency of urination, and had had suprapubic pain for a week. No other symptoms.

The patient was found to be in excellent general condition. She had some cough, but no expectoration. There were lung signs over the right supraspinous region. There was a tumor, evidently the kidney, in the right lumbar region, and a long sausage-shaped mass running down from this tumor into the pelvis, evidently the ureter. There was a tender mass in the right vaginal fornix.

The urine was acid, 1024, contained albumin, pus, and epithelial cells, and was cloudy. No tubercle bacilli were found.

Cystoscopy was performed on March 17 by Dr. Martin Ware, who stated that the left ureter was normal and that the right orifice was oedematous and reddened. The left ureter, on catheterization, emitted clear, apparently normal, urine, the right, thick, white, purulent fluid.

On March 18, under ether anæsthesia, the usual incision parallel to the twelfth rib was made, and the rib was dislocated upward. An

enormous adherent fluctuating kidney was with great difficulty peeled away from the surrounding parts, and the ureter was located. This structure was divided between ligatures and the stumps thoroughly carbolized. It then became possible to fashion a pedicle in which the vessels were felt, but this pedicle, on account of the great inflammatory exudate, was as thick as four adult fingers. It was crushed with a clamp and then ligated with heavy chromicized catgut. The patient was then turned upon her back, an incision about two inches long was made parallel to Poupart's ligament, with its inner termination at the right rectus muscle. Extraperitoneally, the ureter was found, and, having been digitally loosened from above before the patient was turned over, it was easily withdrawn from the wound. On attempting to ligate it closer to the bladder, however, the ureter tore off. The wound was then sutured, a small split tube being put in for a drain. The patient was then again turned over upon her side, and the wound closed in three layers with heavy chromicized catgut for the deeper parts and silk for the skin. The enormous hollow left by the removal of the kidney was filled with saline solution, which was locked in by the tightening of the last two sutures (method of W J Mayo). The pedicle had been carbolized, fearing that some of the thickening may have been due to infective material.

The patient was discharged well, on April 6, 1915, after perfect primary union.

This case was presented to demonstrate the fact that the removal of a tuberculous ureter is an easy operation. It was not done, however, because it was easy but to remove a tuberculous focus which in this case would have been liable to make trouble later. The ureter was found to be tuberculous almost throughout. What would have happened had the patient been treated according to the usual method could not, of course, be said, but she would probably have had a fistula still. She had no fistula now.

Dr Lilienthal said that he had done this operation over twenty times in tuberculous conditions and that he intended to continue calling attention to the method, as he did not think the operation had received the attention it deserves. For some reason surgeons seem to consider it a difficult operation, which it is not. The argument that the ureter gives trouble in only 5, or in 2 per cent, of the cases is a poor one. Surgeons of eminence say, "Take it off as far down as possible, and seldom anything happens." Why take it off as "far as possible"? There is no use in doing more than need be done, but one should surely do all that ought to be done. Dr Lilienthal said that

he had been disappointed to read again of the method of Wm J Mayo, of sewing the ureter in the wound to leave a fistulous opening to close when it would

Dr Lilienthal, in closing, said that although treating the wound without drainage might in some instances be followed by late infection the chances for a permanent cure after primary union were, on the whole, good. In the event of the late appearance of signs of pus the wound could be reopened with little trouble and the ever-present danger of the mixed infection of a recent wound in a tuberculous region would be avoided.

DR ELLSWORTH ELIOT, JR., said that both the late Drs Alexander and Tilden Brown emphasized the fact that the tuberculous lesion was most marked at the beginning and the end of the ureter and that the intervening portion was generally normal. He had noticed at least one exception to this rule in a case of extensive tuberculosis of the kidney in which the ureter was involved not only in the beginning and end but also at the point where it crossed the pelvic brim, where it was so extensively involved as to be adherent to the vascular sheath. Usually, however, the median portion of the ureter is free from pathological change, and under such circumstances the removal of the kidney and as much of the ureter as is accessible through a lumbar incision would leave a possible tubercular focus in the terminal portion only. This was the general opinion expressed in a meeting of this Society several months ago in which the phrase of "the removal of as much as possible of the ureter" evidently referred to the removal of that part of the ureter lying above the pelvic brim.

Dr Lilienthal had stated in the case presented that the lower part of the ureter gave way during the manipulation involved in its removal, possibly the tear of the ureter may have been due to the fact that it was involved in the tubercular process. If he had not misunderstood, Dr Lilienthal also stated that a drain was inserted to this point indicating the possibility of the presence of tubercular necrotic material.

In all those cases in which practically the entire ureter is removed the terminal part must usually be left and that is not infrequently diseased. In this particular part of the body, as elsewhere, the surgeon must be satisfied with the removal of the major part of the tuberculous process and be content with leaving that which he fails to remove to the healing and reparative power of nature, which generally yields satisfactory results. The patient to whom he had referred had no persistent fistula. She was observed for five years, and then died of tubercular meningitis.

DR ALEXIS MOSHCOWITZ said that this subject comes up again and again in the discussion of this condition. Personally, he is rather surprised at it, because he has had no trouble with tuberculous fistula after extirpation of the kidney and ureter, or of as much of the ureter as was indicated. Within the past three months, however, he had been disappointed. He had operated upon a case with the following history. The patient, a young lady, had been referred to him, with a history of frequent urination. She was cystoscoped and the ureters were catheterized, tubercle bacilli were found in the urine from the right kidney. Extirpation of the kidney was advised, and this was done. Upon exposure the kidney appeared to be to all intents and purposes normal, this is merely mentioned in order to show that no tuberculous material was spilled in the wound during the operation. The kidney and about five inches of a perfectly normal ureter were extirpated. On examining the specimen a small tuberculous abscess, not larger than the tip of the little finger, was found in the upper pole of the kidney. The pelvis and extirpated ureter were normal. The wound was closed without any drainage and healed so that the patient was discharged from the hospital in less than two weeks. She returned about a week ago with an undoubted tuberculous infection of the wound, with a sinus discharging pus. In this case, however, the presumption is very strong, that the infection of the wound occurred not at the time of the original operation, but secondarily through a systemic tuberculosis.

DR EDWIN BEER said that there is no doubt that the surgery of tuberculosis is incomplete. One can never remove all the disease, and in following the advice to remove as much as possible one would need to take out some of the bladder as well, for that is frequently involved around the ureter. In the last year he had done six complete ureteronephrectomies, and he selected those in which the tuberculous process had produced a ureter stenosis. He has had to do secondary ureterectomies for tuberculosis, and had found it more difficult than (any other) at the primary stage. He had done immediate suture of kidney incisions in tuberculous cases, and the wound had closed by primary union, but in 6 weeks it had broken down with extensive tuberculosis of the whole wound. How is that to be explained? He had been studying the question by injecting guinea-pigs with blood taken from the patient on the operating table to see whether there was a traumatic bacteræmia. As yet he had found none. Examination of the perineal fat also failed to throw any light on these wound infections. It is peculiar that when a ureteronephrectomy is done through two incisions and nothing is spilt, that the lower wound in which there



remains the tuberculous stump of the ureter almost regularly heals without trouble, whereas the kidney incision which has not been and is not contaminated, is liable to show signs of a tuberculous infection. The question comes up, is this not due to a lymphatic infection as the retroperitoneal lymph-vessels ascend towards the kidney hilus? I believe the persisting lumbar sinuses are more often due to this than to the disease within the ureter that has been left *in situ*, and the fact that such sinuses are not infrequent even when the whole ureter is removed bears out this contention.

DR F KAMMERER said that he rather feared to close a wound tightly after removal of any localized tuberculous focus. Theoretically, of course, after complete eradication of all tuberculous material closure of the wound without drainage was justifiable. But, if any diseased tissues had been overlooked, a recurrence was more likely to develop in a hermetically sealed wound than in one which was allowed in part to granulate. In the latter instance, a certain supervision of the granulating surfaces and an early detection and removal of recurrences was possible. This was especially true of tuberculous disease of the bones with involvement of the surrounding soft parts, but the speaker thought the principle was also applicable to renal tuberculosis, especially in far advanced cases.

#### COMPARATIVE MALIGNANCY OF CARCINOMA OF THE APPENDIX

DR FORBES HAWKES read a paper with the above title.

DR WILLIAM DARRACH reported three cases of carcinoma of the appendix, two of which he had been able to follow, one for six months and the other for a year and a half. The second case occurred in a woman twenty-nine years of age who was operated upon a diagnosis of appendicitis which turned out to be a tubo-ovarian abscess. Routine examination proved it to be carcinoma. The other case was operated upon for acute appendicitis, the proximal portion was found to be gangrenous and the distal portion proved to be carcinoma. The third case he had not been able to follow.

DR ELIOT asked whether in any of the cases there had been a recurrence of the carcinoma after the appendectomy. He himself had never seen any, and had never read of it in the literature.

DR HAWKES said that the first case mentioned in his paper (Berger, 1882) had a recurrence apparently. The appendix was removed. Later an autopsy was performed, and there were metastatic growths.

DR GREEN said that in January of this year the House Surgeon

## CARCINOMA OF THE PAPILLA OF VATER

operated upon what was apparently an acute appendicitis. The appendix was entirely involved by a carcinomatous invasion, being as large as one's thumb. The patient gave a history of having had recurring mild attacks for twelve years. There were glands in the meso-appendix and the omentum was involved, showing metastases. The patient was discharged in January without the knowledge of his condition, and had not reported since.

## CARCINOMA OF THE PAPILLA OF VATER

DR JOHN F ERDMANN presented a young man, a little over eighteen years of age, whom he had first seen in March at the Post-Graduate Hospital. At that time there was a tumor in the right half of the epigastric space, which could be moved very slightly. It presented some symptoms suggesting tumor of the gall-bladder or pylorus. He had a marked lemon color, and gave a history of loss of weight. An X-ray picture led to a diagnosis of tumor or ulcer of the transverse portion of the duodenum, this was corroborated by an exploratory operation. Upon operation a large mass in the third and fourth portions of the duodenum was found, in addition there were two very large retroperitoneal glands imposed upon this growth. The gall-bladder was profoundly distended, showing pressure obstruction of the common duct. Feeling that there might be an ulcerative process, the peritoneum was incised over the involved portion of the duodenum, and stripped off, one gland the size of an English walnut was removed, revealing quite a large hole in the transverse portion of the duodenum with a slough of intestine plugging the opening. A finger was inserted proximally and encountered an almost complete obstruction, then passing it in the opposite direction it was again checked, but not so completely. This mass was hard and apparently malignant. A cholecysto-gastrotomy and a gastro-enterostomy were done, the hole in the duodenum repaired, and the abdominal incision closed. That was on March 23. The lemon color disappeared in five or six days, the patient was able to take food and has continued to do so ever since. The pathologist reported that the specimen was an adenocarcinoma. The patient returned to-day, and examination revealed a recurrence of the condition throughout the upper abdomen.

Dr Erdmann said that this was the second case of the kind that he had presented before the Society—the other having been shown at a former meeting about 18 months before—a male about forty-two years old. In that instance a gastrojejunostomy was done, followed by a cholecystojejunostomy some months later.

## NEW YORK SURGICAL SOCIETY

The sites of these growths were out of the normal anatomical position of the papilla of vater, but he felt that in each instance, owing to the common duct obstruction, in the absence of pancreatic invasions, he had to deal with an abnormally placed papilla with malignancy

DR KAMMERER asked Dr Erdmann if his case might not have been a carcinoma at the papilla Vateri, starting from the glandular epithelium of the gall-ducts. He had himself observed and operated on one such case, about ten years ago, in a man of fifty, in which a carcinoma, about the size of a hazel-nut, was found in the common duct, exactly at the papilla. The growth was removed, but the patient unfortunately died on the third day.

DR MARTIN said that the papilla is quite irregular in its position. Sometimes it is situated near the lower end of the vertical portion of the duodenum, it is possible that a carcinoma might have its origin in a papilla so displaced.

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## MESENTERIC THROMBOSIS \*

BY ELLSWORTH ELIOT, JR., M D

AND

J W. JAMESON, M.D.

OF NEW YORK

THE valuable contributions to the literature of this subject by Jackson, Porter and Quimby in 1904, Trotter in 1913 and by A Reich in 1913 and 1914 render its further elaborate consideration unnecessary at the present time. While the monograph of Jackson, Porter and Quimby comprises an analysis of 214 cases observed in the Boston hospitals and gathered from the experience of individual friends, including in many instances the autopsy findings, the monographs of Trotter and Reich add to the analysis of 262 cases reported in the general literature, the results of the ligation of mesenteric vessels in animals. Individual experience is, however, always of value and the writer believes that the wide variability in the extent of the lesion, in its rapidity of development and consequently in its clinical manifestations warrants the report of additional data, although the number of cases which occur in the experience of any one surgeon is necessarily small.

The normal arrangement of the intestinal circulation is well understood. The main artery supplying any segment of the large or small intestine is usually an end artery, while the corresponding vein, if obstructed, is ordinarily without sufficient collateral circulation to avoid serious nutritive disturbances. It is only within the arcade proper that the intestine is provided with adequate collateral circulation, and even in this location the size of the segment of which the viability can be so maintained is necessarily small. Thus, it is common experience that vessels near the mesenteric attachment can be ligated without danger, and in one instance an artery and vein within several inches of the root of the mesentery supplying the ileum, that had been ruptured

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\* Read before the American Surgical Association, June 10, 1915

by subcutaneous trauma, were ligated by the writer without subsequent complication. Between the small number of cases in which the collateral circulation may be satisfactorily established and those in which its failure is followed by necrosis, there must be a zone in which the viability of the affected portion hangs in the balance, and in this group, while the collateral circulation may be sufficient to prevent extensive necrosis it may not be adequate to prevent the death of one or more patches of the intestinal mucous membrane, namely, of that part of the intestinal wall which is most remote from the centre of circulation, resulting subsequently in perforation or in healing with cicatricial contraction. Finally the lesion with its corresponding clinical picture may be modified by the more or less rapid extension of the thrombus in either direction until so many vessels are occluded that necrosis becomes inevitable.

While it is unnecessary in those cases in which there is necrosis of the entire intestinal wall to describe in detail the lesion of the resulting peritonitis, it is most important to call attention to the fact, that the thrombotic process may be insufficient to permanently impair the viability of the affected segment. This fact has been satisfactorily demonstrated by several autopsy records, in which the collateral circulation in a large segment of intestine has been satisfactorily established where the formation of the thrombus has been particularly slow, and by the case reported by Martin in which the superior mesenteric vein was found thrombosed with the intestine in many places ecchymotic and congested. The abdomen was closed without further interference and the patient recovered after a stormy convalescence. In this case there was a history of tight lacing on the evening preceding the attack. The possibility of temporary interference with the circulation by small thrombi, rapidly forming but of limited extent, seems to be demonstrated by the occurrence, in the history of many cases, of brief attacks of severe abdominal pain prior to the onset of the final attack in which laparotomy or subsequent autopsy reveals a condition of complete necrosis.

A brief consideration of the etiology of mesenteric thrombosis is justified in view of its close relationship to the diagnosis of this often obscure lesion. It is also most important to emphasize the fact that cases occur in which no satisfactory cause can be elicited. The most frequent causes may be grouped as follows:

(1) The occlusion of a large mesenteric artery by the lodgement of an embolus of cardiac or arterial origin, or from some distant focus of infection.

(2) The occlusion of a large mesenteric artery by the formation of a thrombus *in situ* either from the erosion of the arterial wall or from trauma

(3) The occlusion of a large venous trunk by the formation of a thrombus due to the erosion of a chronically inflamed intima, to the extension of a small infected thrombus in a portal radical, most commonly associated with acute inflammation of the appendix, to the presence of adventitious toxins in various infectious processes, or to the disorganization of the blood associated with the severe anæmias, diabetes and with the latter stages of the wasting diseases

The much more frequent involvement of the superior rather than the inferior mesenteric artery is accounted for by the larger size of the former vessel, and by the fact that it arises from the abdominal aorta nearer the heart and at an angle mechanically favorable to the direct passage of embolic material

The importance of a specific history and the consequent positive Wassermann reaction is self-evident

In a very considerable proportion of cases, no adequate cause can be discovered. This is observed most frequently in mesenteric thrombosis of venous origin forming a group of cases of special interest for the reason that, although the resulting necrosis is usually complete, the affected loop does not generally exceed 12 to 24 inches in length and, in the absence of any one of the associated lesions just enumerated, the chances of a successful resection are peculiarly favorable. That cases of mesenteric thrombosis not infrequently occur without discoverable cause and in patients with no history of previous illness cannot be too strongly emphasized. While the etiological importance of the group of circulatory disturbances, already mentioned, must always be recognized, the fact that, occasionally, not one can be identified must not be overlooked and must not lead to the positive exclusion of mesenteric thrombosis in the diagnosis of acute and subacute obscure abdominal conditions

In explanation of the occurrence of these obscure cases only theories can at present be offered. Reich is responsible for the ingenious suggestion that thrombosis results directly from the action of toxic material which, after its absorption by the intestinal lymphatics, passes into the lymphatics of the venous walls and, in that position, indirectly coagulates the blood in the interior of the vessel. The writer wishes to advance the theory that there may be an intimate relation between abnormal intestinal fermentation and the subsequent absorption of the resulting chemical products by both the lymphatic and venous radicals,

leading on the one hand to peritoneal adhesion with the formation of adhesions and on the other to the possible but rare coagulation of venous blood. Pathologically, at least, the presence of organized extensive peritoneal adhesions in patients with no history of a prior peritonitis is not infrequent. The writer recalls one instance in a girl of sixteen, operated for acute obstruction from band formation with a total absence of any prior abdominal difficulty.

In view of its bearing on the etiology of thrombosis of the portal radicals, the writer reports briefly an instance of extensive thrombosis of the veins of the great omentum, adherent in places to an underlying fibroid, reaching to the level of the umbilicus but with no indication of previous torsion or of recent inflammation. The thrombosed vessel, as large as the adult little finger, passed upward superficially to the transverse colon, through the gastrocolic omentum, to the greater curvature of the stomach, where, after being joined by the gastro-epiploica-dextra vein, involved for a short distance to the left also in the thrombotic process, it passed to the right and ceased to be thrombotic at a point near the junction of the superior mesenteric and portal veins. There was no circulatory change in any part of the gastro-intestinal canal. Prior to the operation the patient had had attacks of severe cramp-like abdominal pains. In the course of the supravaginal hysterectomy, the great omentum was ligated below the level of the transverse colon, the thrombotic vessel having previously been incised and the clot cautiously expressed from above downward. Subsequent microscopical examination of that portion of the thrombosed vessel in the amputated omentum showed no abnormality, and bacteriological examination of the clot which was moderately soft and not organized showed no organism. Is this instance of thrombosis, unique in the experience of the writer, to be ascribed to a mechanical factor such as pressure on or trauma directed against the abdominal wall? During the two years that have elapsed since the operation there has been no indication of any further abdominal circulatory disturbance.

The grouping of the clinical symptoms of mesenteric thrombosis into a picture that may be considered fairly characteristic meets with the greatest difficulty. In rapidly forming thrombus involving a considerable part of the intestinal tract, the invasion is sudden and the course most rapid, with evidences of extreme shock. On the other hand, where the thrombosis is of slow formation and the segment of intestine is small, the invasion may be much more gradual and the course may be prolonged. That the individual symptoms also widely vary is seen in the generally accepted classification adopted by Reich and sub-

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stantiated by the analysis of 262 cases, in which mesenteric thrombosis is divided into two distinct groups

(1) A group characterized by the classic symptoms of acute intestinal obstruction in which there is acute circulatory disturbance—pain, vomiting and complete constipation being especially prominent symptoms

(2) A second type, in which the pain and vomiting are associated with the occurrence of repeated watery stools, occasionally containing blood

Reich, in his analysis states that diarrhoea occurs in 41 per cent of the cases and that in 26 per cent the stools contain blood. He also states that in 16 per cent the vomitus contains blood

The source of the watery discharges has proved largely a matter of speculation. Usually their origin has been referred to an abundant exudate from the intestine below the site of the lesion. It is quite possible, however, that the bloody and serous discharges come from the wall of the thrombosed intestine itself and that the intestine directly above the lesion is as much a source of the serous discharge as is that directly below. To be sure, paralysis of intestinal peristalsis in mesenteric thrombosis is commonly ascribed to the affected loop, but that this does not always occur, at least in the early stages, is clearly proved by the interesting fact observed in Case III, in which a typical bismuth stool followed the exhibition of that drug only a few hours before the operation

While the physical examination of the abdomen is of the greatest importance in a condition in which such diametrically opposed symptoms may occur, it is particularly essential in the second group, in which the diarrhoea, especially if associated with bloody stools, strongly suggests the possibility of a colitis—a diagnosis rendered still more probable if the pain, which, in mesenteric thrombosis, is usually atypical in both its location and character, happens to be paroxysmal and referred to the course of the large intestine

Fortunately the character of the physical signs is much more constant than that of subjective symptoms. They are chiefly the result of peritoneal irritation in some part of the abdominal cavity, depending upon the position of the affected intestinal loop. They comprise diminished and at times asymmetrical respiratory movement of the abdominal wall, rarely visible peristalsis (especially in the subacute cases), equally rare localized meteorismus, usually localized tenderness, and the all-important symptom of muscular rigidity which, even in mesenteric thrombosis of limited extent, is apt to be more diffuse than localized



In the acute type the rigidity usually obscures a tumor, while in the subacute type, the rigidity is less intense and a tumor is occasionally felt. Occasionally the fluid in the peritoneal cavity is sufficiently abundant to give a dull note, especially with the aid of auscultation. Shifting dulness has also been obtained. The writer does not consider, however, the movement of the patient's body necessary to elicit this symptom in this or in any other form of infectious peritonitis advisable, on account of the liability of the spread of the infection to distant parts of the peritoneum.

The frequency with which the affected loop lies in the pelvis emphasizes the importance of a rectal examination. In addition to the localized tenderness a sense of fulness is sometimes elicited, and in these subjects, on bimanual examination, an actual tumor may be felt. The leucocyte count is also of considerable importance. As in other infectious processes in the peritoneum, an increase in both the general and the polymorphonuclear count is usually obtained. Together the physical signs are those of a spreading peritonitis and resemble closely the physical sign associated with an infected appendix, a duodenal perforation, an infected gall-bladder or an acute pancreatitis, according to the position of the affected loop. Finally, the physical signs differ not only in location but in their intensity. In extensive thrombosis of rapid formation the abdomen may be markedly retracted and the rigidity is diffuse and intense.

*Treatment*—Operation is indicated in all cases uncomplicated by serious or advanced associated visceral changes. The presence of a diffuse and persistent (although not necessarily intense) abdominal rigidity, alone, warrants for prompt exploration. The difficulty in diagnosis and the consequent likelihood of confusing this condition with some more common infectious abdominal process, makes the operation largely exploratory, and in the larger number of cases the actual condition is recognized only after the opening of the abdomen. When the peritoneal cavity is opened the presence of a dark-colored if not actually bloody fluid almost immediately excludes either an infected appendix, a gastroduodenal perforation, or an acute cholecystitis. A fluid of this character is usually associated with some form of intestinal obstruction due to circulatory interference. The incision should then, if necessary, be sufficiently enlarged to permit the exploration of the entire intestinal tract, beginning preferably at the ileocaecal junction. It is not always easy to distinguish the early changes indicative of thrombosed intestine. The color changes are not always marked and the smooth glistening ap-

pearance of the serous coat may remain unimpaired for some time. On this account some observers prefer postponing the operation to the second or third day after the invasion. Such delay, however, the writer considers inadvisable. Instances of this kind are very uncommon and, when they do occur, ordinarily indicate the involvement of a very considerable portion of the intestinal canal, leaving no normal intestine for comparison. Such extensive thrombosis, it is needless to add, indicates the immediate cessation of the operation. Theoretically, it is possible to conceive of a mesenteric thrombosis in which the establishment of the collateral circulation in a portion of the affected intestine would permit a successful resection of the remainder. Owing to its rarity however, such a possibility need not enter into the question of early operation.

When the nature of the lesion has been determined further measures depend entirely upon its extent. In general resection of the affected intestine and as much on either side as is necessary to insure the viability of the divided ends, followed by the restoration of the continuity of the intestinal canal, is the treatment of choice. Reich has grouped the conditions which preclude the possibility of successful resection as follows: (1) portal thrombosis, (2) multiple infarcts, (3) infarcts of the descending colon and sigmoid, (4) extensive infarcts including those with no sharp line of demarcation. Any one of these conditions, it is quite evident, makes it hopeless to continue the operation beyond the exploratory stage.

In their absence an effort to relieve the patient is entirely justified. If the condition of the patient is good it is generally agreed that resection, followed by some form of anastomosis, should be carried out. Such a procedure, however, may require too long a time in advanced cases, especially when peritonitis has developed. Under such circumstances the operation may be terminated, after the removal of the necrotic intestine, by leaving the divided ends of the intestine in the wound and adding the anastomosis as soon as it is warranted by the improvement in the general condition of the patient.

The methods of re-establishing the continuity of the intestinal canal do not differ materially from those ordinarily in use after resection of strangulated intestine from any cause. Lateral anastomosis is always the operation of choice where the divided ends are of unequal calibre, as between the large and small intestines, as well as where one or both are distinctly œdematous. Ordinarily such œdema should preclude the division of the intestine at that point, but the extreme length of the infarct may compel the taking of such a risk in order to avoid the

sacrifice of too large amount of intestine. How large an amount of intestine may be successfully resected is naturally uncertain. Reich, however, refers to the successful resection of MacGuire of 336 centimetres of the ileum. In cases in which the small extent of the infarct enables the resection to be carried out in small intestine unquestionably healthy, an end-to-end anastomosis is not contraindicated. The comparative value of these different methods is difficult to establish owing to the small number of successful cases. In Reich's tabulated list of 18 recoveries in 91 operated cases anastomosis was effected in one by the end-to-end method by suture, in seven by the end-to-end by button, in three by the side-to-side by suture, and in two by the side-to-side by button, while in four the anastomosis was secondarily re-established after primary resection with the suture of the divided ends in the wounds by the end-to-end suture method. This is the method of choice advocated by Jackson, Porter and Quimby. The fatal cases included 20, in 13 of which a resection with primary anastomosis was done as follows. By the end-to-end suture method, 4, by the end-to-end button method, 4, and by the side-to-side suture method, 5. Resection with secondary anastomosis was done in 7 cases.

A comparison of the methods employed in the successful and fatal cases, respectively, is without value for the reason that the conditions, especially those relating to the age of the patient, the extent and duration of the lesion, and the associated peritonitis, differ widely. Comparison of the methods employed in the successful cases is interesting in that it shows that the post-operative complication of fecal fistula has occurred, irrespective of the method adopted, as follows. In one case of resection followed by end-to-end-suture method (the only case so treated), there was a fecal fistula. It also occurred in 3 of 7 cases where the anastomosis was established by button, in 1 of 3 cases of side-to-side-suture method and in 1 of 2 cases where the lateral anastomosis was established by button. Even in the 4 cases in which secondary anastomosis was made a fecal fistula developed in one and required two attempts to effectively close it. This latter method is especially recommended by Jackson, Porter and Quimby because it minimizes the risk of a comparatively prolonged operation as well as the post-operative risk of leakage at the point of suture from the extension of the thrombosis. That this may occur, even when at the time of resection the arteries divided in the mesentery spurted, is well demonstrated by the case of Weil, in which autopsy showed a condition of necrosis in the sutured ends of jejunum which at the time of operation had been unquestionably viable. To sum up, secondary

anastomosis is indicated (1) when the serious condition of the patient demands the completion of the operation in the shortest possible time, (2) where the line of demarcation on either side of the infarct is not sharply defined, (3) where the extreme length of the infarct for reasons already mentioned warrants the division of the intestine at a point which may be œdematous, (4) where the infarct does not involve the upper part of the jejunum. Should the lesion involve this part of the intestine it is self-evident that a primary anastomosis can alone preclude the rapid loss of strength which would follow the establishment of an artificial anus. Kolbing's case is an illustration in point. The infarct involved the beginning of the jejunum so that after its resection an end-to-end anastomosis was impossible on account of the short length of the duodenal end. This was accordingly closed and the continuity of the alimentary canal established by an anterior gastro-enterostomy. The patient made a brilliant recovery, suffering only from a temporary distention of the stomach, which was relieved by lavage.

Conversely, immediate anastomosis after resection may be done in cases where there is a sharp line of demarcation, where the infarct does not exceed ten or twelve inches in length, where the infarct involves the ileum and where the general condition of the patient warrants the necessary extension of the operation. In every case of primary anastomosis, post-operative leakage is to be avoided, by excising well beyond the limit of normal circulation, by reinforcing the line of anastomosis if possible with an omental flap, and by leaving the sutured loop approximately near the anterior abdominal wall, a short non-rigid drain being inserted to its immediate proximity, so that in the event of leakage, the discharge will be conducted away from the peritoneal cavity.

While post-operative leakage is to be feared more than any other complication, leading either to a fatal peritonitis or to the formation of a fecal fistula, other important post-operative complications have been observed. Thus Codman reports an instance of acute gastro-mesenteric ileus, which was relieved by lavage and posture. Instances of acute obstruction from adhesions, of the retention of the button used in the establishing of the anastomosis, of the formation of a gradually shrinking mesenteric tumor from the swelling of the sutured mesentery, of parotitis and of the occurrence of bloody stools. These different complications occurred in some of the successful cases of resection. Most of the fatal cases in Reich's statistics died shortly after the operation, and in all but a very small number autopsy showed an extension of the pre-operative peritonitis.

The late results in the successful cases of resection should be investigated. Where the cause of the thrombosis cannot be discovered, or where the thrombosis is the result of some vascular lesion which persists necessarily after the operation, a recurrence does not appear at all unlikely. In the three cases herewith reported, one is well and strong without indication of abdominal or other trouble at the end of two years, a second at the end of 20 months, and in the third 10 months only have elapsed since the operation.

Of the successful cases collected by Reich, the condition of Delatour's patient three and one-half years after the operation was entirely satisfactory. There had been no recurrence of any abdominal symptom. An equally favorable condition of the patients of Drs. Ashley, Green and Codman can be reported almost four years after the operation. During that time, however, Dr. Green's patient has had a localized inflammatory process in the apex of one lung which has entirely disappeared. I am greatly indebted to these gentlemen for their kindness in permitting me to include their interesting results in this paper. Although the cases are too few to draw any definite conclusion, the prospect of a permanent cure seems to be quite favorable. The history of the cases herewith reported follows.

To the successful cases reported in the table of Reich must be added Tosatti's case which has since been published, in which a portion of thrombosed jejunum, developing after the removal of an infected appendix, was resected, followed by immediate end-to-end-by-suture anastomosis. Recovery was complicated for a time by the persistence of a small intestinal fistula. Cases by Davis and Weil, abstracts of which follow, have also been reported since Reich's publication.

CASE reported by DAVIS. Female forty-five. Five years ago a similar attack of between 2 and 3 days' duration was successfully treated by morphine and laxatives. Two years ago there occurred a shorter and less severe attack.

For days before admission patient suffered from general though not severe abdominal pain. On the first day of menstruation the pain became severe and later paroxysmal. The pulse increased in frequency and the temperature became subnormal. The abdomen was tympanitic and there was tenderness in the lower left quadrant. The patient was in shock and her condition suggested strongly an ectopic pregnancy. On the following day, there was vomiting and the tenderness was more marked and was associated with slight rigidity. On the evening of that day an enema brought away a bloody fluid result. The pulse was 130, the temperature 96. The general leucocytosis was 35,000. There was visible peristalsis and signs of fluid in the flanks. The abdomen was distended. Vaginal examination was negative.

Operation about 40 hours after invasion. Under ether, the peritoneal cavity was opened through a 3-inch, median, suprapubic incision and 10 ounces of

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bloody fluid evacuated. A loop of small intestine, about 18 inches in length, of rigid consistence and of a deep purple color, was resected. Its mesentery was thickened with vessels distinctly thrombosed. The line of demarcation was sharply defined both above and below. The divided ends of the intestine were brought into the wound, Mixer's tubes being inserted and left in place for 5 days. The intestinal discharge caused considerable irritation of the skin. Two weeks later an end-to-end anastomosis was done, a drain being inserted to a small abscess which was found at the point of mesenteric ligation. Patient recovered without further complication.

CASE reported by WEIL. Female fifty-two. History of obstipation for three years. Invasion sudden with general abdominal pain and vomiting. Abdomen was soft with tenderness and resistance over the bladder and left pelvic brim. There was a slight distention. On vaginal examination there was a sensation of a cylindrical body running from right to left and exquisitely sensitive. An enema brought away some fecal particles but no blood. There was no sign of ascites. The pulse was 90 and the temperature was normal. Immediate operation.

On opening the peritoneal cavity a large amount of serosanguinolent fluid was found. A loop of small intestine of at least two feet in length and of bluish-red appearance was exposed. It was separated both above and below by a sharp line of demarcation and was without peristaltic movement. The mesentery was œdematous and its veins were thrombosed. The proximal intestine was contracted. The necrotic intestine was resected and an ileocolostomy with the transverse colon was done. The patient recovered.

Through the kindness of Dr J H Wheelwright, the following case of mesenteric thrombosis treated successfully by him, is herewith reported, the details of the history being furnished by my former house surgeon, Dr O C Pickhardt.

CASE I.—Female, aged fifty-seven, single, was operated on for a right femoral hernia 18 years ago. A second operation was done 15 years ago for a right ovarian cyst. At that time the appendix was removed. A third operation was done 9 years ago for numerous ovarian cysts of various sizes.

Patient has had bad varicose veins as long as she can remember which have never ulcerated. A year and a half ago patient had a bad fall, striking abdomen against the kitchen floor, and to this accident the present trouble is attributed.

From time to time has suffered from soreness in the lower abdomen in the region of the cicatrices. Several days prior to the invasion of the present attack, this soreness had been felt. The acute invasion occurred shortly after eating several prunes, with very acute pain above the level of the navel. The pain was shooting and continuous in character and radiated from right to left. Very shortly it could be felt working its way down the midline to the lower abdomen. The pain continued with occa-

sional griping exacerbations up to the time of operation. It was so severe that it could not be controlled by morphine. Two hours after onset, vomiting occurred. The bowels had moved normally a few hours before the attack began, and thereafter, prior to the operation, only with an enema and without sign of gas or blood.

Three hours after the invasion, on physical examination, the whole abdomen was found tender, especially in the midline midway between the navel and symphysis. There was symmetrical rigidity of both recta at the point of maximum tenderness. No mass could be felt and there was no distention. Sounds of active peristalsis were heard over the entire abdomen. Rectal examination was negative.

Twelve hours after the invasion a second physical examination was made, and a small, tender, movable mass was felt just to the right of the midline below the navel, which gradually became larger and more tender. Four hours later there was beginning distention and the mass could be distinctly felt through the rectum.

The patient looked very ill. The pulse was 120, temperature 103°, and respiration 28. The blood count was not taken. The vomiting had been repeated but there was tenesmus.

*Operation* (18 hours after invasion) by Dr. Wheelwright, Dr. Pickhardt assisting—Under gas and ether anaesthesia the peritoneal cavity was opened through a six-inch median incision and a pint of dark bloody free fluid was found and removed. About three feet from the ileocaecal valve a loop of small intestine, 15 inches in length, of a dark purple color and free from any adhesions except those of fresh fibrin, was found. It was separated from the intestine above and below by a sharp line of demarcation and presented small areas of focal necrosis without perforation. The attached mesentery was markedly infiltrated and all the veins were filled with thrombi. No pulsation could be felt in the mesenteric vessels. The necrotic intestine was excised, leaving two inches of viable intestine on either side and an immediate end-to-end-by-suture anastomosis done. The abdomen was somewhat distended after the operation, but on the second day gas was expelled, again in larger quantities on the fourth day, and on the eighth day a normal, large, solid movement occurred without the aid of catharsis. The patient recovered without further incident.

Through the courtesy of Dr. J. W. Jameson, the following case is herewith reported:

CASE II.—Male, twenty-two, single. Referred to Dr. Jameson by Dr. L. R. Williams. Past history negative until several

months ago, when an attack, similar but less severe than the present, occurred, lasting 24 hours. The present attack began 34 hours before the admission of the patient to the Presbyterian Hospital, after eating a hurried meal, with severe sharp pain in the vicinity of the umbilicus increasing in intensity, which, after several hours, was referred to the lower part of the abdomen. It continued without intermission and was so severe that it was not relieved by morphine. Soon after the invasion vomiting occurred, the vomitus consisting at first of food, then of bile-stained mucus. The bowels, ordinarily constipated, moved several times with catharsis, but no blood was noted in the stool. On the day of admission to the hospital, the vomiting continued and was projectile. At no time was blood noticed in the vomitus.

*Physical Examination*—The patient looks sick. The face is flushed and the tongue is dry and coated. The pulse is 144, respiration 36 and the temperature 101°. The abdomen is slightly distended, without respiratory movement, and is generally tender, the tenderness being most marked below the level of the umbilicus and on the right side in which latter location the rigidity is board-like. There is dullness in both flanks. Abundant peristaltic sounds can be heard over the entire abdomen. On rectal examination there is tenderness on both sides.

The general leucocytosis is 36,000, the polymorphonuclear is 90 per cent.

*Operation* (36 hours after invasion) by Dr. Jameson—Under gas and ether anæsthesia, the peritoneal cavity was opened through a two-inch "McBurney" incision and about two quarts of dark bloody fluid was removed. Examination of the appendix was negative. On further examination of the adjacent ileum, a loop of black intestine about 14 inches in length and two feet from the cæcum was brought into the wound after making a four-inch median incision. The necrotic intestine was swollen and spongy with a sharp line of demarcation both above and below. The mesentery was black and swollen and no pulsation could be felt in its vessels. The gangrenous intestine was excised at a distance of two inches on either side of the line of demarcation and an end-to-end-suture anastomosis added. There was no bleeding from the thrombosed veins of the divided mesentery. After the insertion of a cigarette drain to the region of the mesentery, both abdominal wounds were closed in the usual way.

There was no post-operative vomiting and except for moderate distention the patient's condition was entirely satisfactory until the sixth day, when a fecal fistula developed through which the entire intestinal contents were discharged. Ten days after the first operation, the abdomen was again opened. The divided ends



of the intestine were separated by a considerable interval and there was no evidence of any previous suture except in one place on the mesenteric border. There was an abscess containing a half ounce of pus below the site of the anastomosis. The open ends of the intestine were then closed by inverting with purse-string suture, and a lateral anastomosis was done at a point lower down. A rubber tissue drain was inserted and the wound closed with strong retention sutures. The patient rallied well after the operation and except for the persistence of a purulent discharge through the lateral incision for two weeks made a satisfactory recovery. Recovery was also complicated by a left femoral phlebitis.

Two months after the first operation, patient suffered from an attack of intestinal obstruction. On opening the abdomen through a left pararectal incision, the small intestine was found to be constricted by numerous adhesions and in one place near the anterior abdominal wall it was definitely kinked. The obstruction was relieved and the patient has been well since.

CASE III — Male, sixty, physician. Many years ago patient had typhoid fever complicated with a right femoral phlebitis. With this exception he had always enjoyed good health, although latterly showing a moderate degree of arterial sclerosis with hyaline and granular casts in the urine. Two days before admission to the hospital, in the evening after dinner, while taking a stroll patient experienced abdominal discomfort with a feeling of nausea. Earlier in the day he had carried two moderately heavy dress suit cases and thought that this might have caused some temporary indigestion. On the following day the discomfort continued and patient was unable to retain any food in his stomach. *Notwithstanding the usual remedies for an attack of "indigestion,"* the symptoms continued unabated and later in the day pain developed, referred at first to the entire abdomen and later shifting over to the right side opposite the navel. After a restless night and with pain alleviated by an injection of morphine, patient travelled all day from Buffalo to New York where he was seen by the writer about 48 hours after appearance of the first symptoms. The bowels during this time had moved several times and twelve hours before the operation patient had had two formed characteristic bismuth stools, having taken that drug for the relief of what at the time he considered was an attack of functional disturbance of the intestine.

Physical examination showed an abdomen free from distention, with tenderness and rigidity well marked on the right side opposite the level of the navel. There was diminished respiratory movement of the abdominal wall. The pulse ranged between 120

and 130 but the temperature was not normal. The general leucocyte count was 25,000 with a polymorphonuclear count of 95 per cent.

*Operation* (50 hours after invasion) by Dr Eliot—Under gas and ether anæsthesia the peritoneal cavity was opened through a McBurney intermuscular incision, and a considerable quantity of amber fluid found near the parietal peritoneum. The appendix was normal. Exploration of the adjacent ileum, however, showed a purple loop of 14 inches in length separated from the healthy intestine both above and below by a sharp line of demarcation of which the lower extremity was about ten inches from the ileocæcal junction. The necrotic loop was carefully withdrawn into the incision, which had been previously extended in both an upward and downward direction, and resected, the line of division below passing through the intestine two inches from the ileocæcal junction. The veins in the attached mesentery were extensively thrombosed and no pulsation could be felt in the mesenteric vessels. The resection was followed by immediate end-to-end-by-suture anastomosis, and after the removal from the pelvis of a considerable quantity of dark-colored bloody fluid and the insertion of a cigarette drain the abdominal wound was closed.

The patient recovered from the operation and for 24 hours was in excellent condition, the pulse ranging around 120 without distention of the abdomen and without any material discomfort. During this time there was passed a quantity of gas from the bowel. At the end of this interval there was a sudden change. The patient was seized with intolerable abdominal pain which could not be controlled by morphine and which caused him to cry out. The wound was immediately reopened and the pelvis was found to contain an abundant quantity of intestinal contents. The anastomosis was tight and well sealed with plastic exudate over the line of suture. Further exploration showed the intestinal contents to issue from a perforation about six feet from the ileocæcal junction in an area evidently the site of thrombosis. This was closed and the pelvis drained, but the patient died 8 hours afterwards, the abdomen having become extremely distended. Microscopical examination of the resected intestine showed extensive venous thrombosis.

CASE IV—Male, thirty-eight, referred by Dr Bogert. Patient has always enjoyed the best of health. A farmer by occupation he has led an out-of-door life under excellent hygienic conditions. He is of athletic build and gives the impression of being an unusually strong man.

On June 23, between 9 and 10 A M., and one hour after the

usual daily movement of the bowels, patient was seized with abdominal pain. This was referred to the entire abdomen and was equally intense on both sides. It was not increased by respiration nor movement of the body. It was dull, constant and persistent. The patient was not sufficiently ill to be confined to bed and went up and down stairs, lying down occasionally on the lounge. There was no nausea or vomiting at any time during his illness. At night the pain, still without definite location, was sufficiently severe to require morphine, by which it was relieved. On the second day of his illness, the pain continued and there were several discharges of small amounts of blood from the bowel. A high oil enema was given and brought away about a pint of dark-colored blood. There was no further discharge of blood from the bowels or of gas or of any kind of movement until after the operation.

On the third day, the pain still continuing, the patient was brought to the Nassau Hospital and seen by the writer for the first time. The jolting of the ambulance increased the pain but after his arrival at the hospital the pain became less severe and almost disappeared. During the entire three days the pulse had not exceeded 80 nor the temperature  $100^{\circ}$  and, just prior to the operation, the pulse was 68 and the temperature a fraction above  $99^{\circ}$ .

Physical examination showed no sign of circulatory disturbance. The patient looked well and there was no indication of any serious illness whatever. Examination of the abdomen showed diminished respiratory movement on the right lower quadrant and at a point opposite the level of the navel, on the right side, and above the usual location of the appendix there was decided tenderness and rigidity. A rectal examination elicited tenderness on either side. No tumor was felt either through the abdominal wall or through the rectum. No leucocyte count was taken.

*Operation* (60 hours after invasion) by Dr. Eliot—Under gas and ether anæsthesia the peritoneal cavity was opened through a mid-incision between the navel and the pubis, and a considerable quantity of bloody fluid evacuated. The appendix was normal. About two feet from the ileocæcal junction a necrotic loop of small intestine, about 20 inches in length, was withdrawn from the pelvis into the abdominal wound. There was some odor but no perforation. The line of demarcation was distinct both above and below. The veins in the attached mesentery were thrombosed and no pulsation could be felt in the mesenteric vessels. The necrotic intestine was resected through a point 6 inches distant from the lines of demarcation with immediate end-to-end-by-suture anastomosis, and the wound closed after saline

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cleansing of the pelvis and the introduction of a small rubber tissue drain just beyond the parietal peritoneum

The patient's recovery was prompt and without complication. He has had no further trouble since the operation, but tires more easily at his work. At present, 22 months after the operation, the patient's health is excellent.

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## A REPORT UPON ONE CASE OF SPLENECTOMY \*

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*Splenic Anæmia Splenectomy Mesenteric Thrombosis Resection of Intestine Death*—A Russian cap-maker, eighteen years old, entered the Massachusetts General Hospital on April 26, 1914 (hospital number 195177)

*Family History*—Mother living and well, but subject to nose-bleeds lasting from 5 to 15 minutes, about every 3-6 weeks. The oldest brother has the same kind of nose-bleeds as the mother. The grandfather on the mother's side also had the same kind of nose-bleeds. There was no family history of bleeding on the father's side. There were no bleeders in the family or ancestors. Four brothers and two sisters are living and well.

*Personal History*—No rheumatism, sore throats, jaundice or malaria. Has had three attacks of bleeding as follows:

First, when eight years old had a swelling in the right hypochondrium the size of a cocoanut, with pain and question of fever. This had to be opened within a week, and "one-half a pail of blood and white material was obtained." Remained in bed for three months because of weakness. No more bleeding or ecchymosis, but one year later a lump in the left side under the ribs began to appear and within one month reached its present size, remaining the same until now. Dull pain limited to the tumor mass has continued.

Second, when fifteen years old suddenly and without cause had bleeding from nose and mouth, ecchymosis over the body. The nose was packed but the bleeding continued 12 hours. He remained in bed for 3 weeks and did not work for 3-4 months.

Third, one week before entrance to the Hospital he was feeling all right. He rode a bicycle and got very heated. During the night his nose began to bleed, but stopped by morning, when mouth began to bleed and bled all the week, although the patient kept at work. One day after onset his arms and legs became black and blue, but this did not last. He gave up work at the end of the week because of weakness, and, his nose beginning to bleed again, he came to the Accident Room for treatment. Nose was packed and he was sent to the ward for study.

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\* Read by title at the Meeting of The American Surgical Association, in June, 1915

## CASE OF SPLENECTOMY

*Physical Examination* — Poorly nourished and fairly developed boy, very pale. Skin bluish tint, dry and harsh, with minute ecchymotic spots over the body, pin-head in size. Many large ecchymotic areas bluish black in color. On left shin is such a spot with raised hard lump in the centre whose crater is yellowish-white. Many of these areas have hard nodules in the centre which are not raised. Sclerae bluish. Mucosa very pale. Tongue clean. Teeth sound. Slight pyorrhoea. Throat pale, tonsils slightly enlarged. Glands. Chain of small glands (nodes) down side of left neck and also in left axilla. Heart. Apex seen and felt in fourth space. Sounds regular, fair quality. One rough, blowing systolic murmur heard at third space left, also heard throughout whole precardia.  $P_2 > A_2$ , and positive. Pulses equal, fair volume, low tension walls not felt. Chest barrel-shaped. Whole right chest seems dull. Flatness, diminished breathing and fremitus at the base. A few fine râles on deep inspiration. Abdomen. Large, bulging on sides, lax, tympanitic, no dullness in flanks, and no shifting dullness. To the left of the median line below umbilicus, extending almost to pubes, there is a hard mass size of a large plum, slightly tender, movable laterally in abdominal wall. Liver dullness from fifth rib to costal margin. Edge not felt. Spleen extends 14 cm below costal margin in the nipple line, easily palpable and movable, notch felt at costal margin, non-tender. Kidneys not felt. No costovertebral tenderness. Rectum. No mass in the pelvis.

X-ray of chest May 5. Several small dense white glands scattered about lung roots, and markings running toward apices. Otherwise chest negative.

Urine. Cloudy, 1030 to 1018, no albumin, no sugar, acid, no blood, urates rare, occasional red blood-cell.

Blood. Wassermann negative.

April 26. white cells, 8000, hæmoglobin, 35 per cent, red cells, 2,980,000. Smear. Neutrophiles, 84 per cent, small mononuclears and large mononuclears, 12 per cent, eosin, 1 per cent, transitionals, 3 per cent. Reds, marked achromia. Variation in size and shape. No polychromatophilia or blasts. Blood platelets much reduced (two seen).

April 26. Transfusion of 600 c.c. of blood brought hæmoglobin from 35 per cent to 50 per cent. Additional transfusion of 150 c.c. of blood brought hæmoglobin from 50 per cent to 55 per cent.

April 26. Coagulation time 10 minutes 30 seconds.

April 27. Coagulation time 4 minutes 30 seconds.

April 27. Blood cultures all sterile.

May 7. Hæmoglobin, 55 per cent, white cells, 3800, red

cells, 2,536,000 Smear neutrophiles, 63 per cent , small mononuclears and large mononuclears, 33 per cent , eosin, 1 per cent , transitionals, 1 per cent , megaloblasts, 2 per cent Achromia Slight variation in size and shape One megaloblast

May 27 Hæmoglobin, 58 per cent , white cells, 3800 , red cells, 2,800,000 , neutrophiles, 55 per cent , basophiles, 45 per cent Blood plates rare Coagulation time 5 minutes Stools markedly positive for guaiac test

On May 22 bleeding started again from nose and stopped without packing after a short time The family consented to operation for the removal of the spleen, and preparation was started There was no further bleeding

On May 29, exploration under gas and ether anæsthesia showed no free fluid in the abdomen The abdominal incision oozed more than normally, but not more than usual in an anæmic individual The spleen was secured by multiple adhesions to the parietal peritoneum, omentum, transverse colon, and gastrocolic omentum The adhesions were divided and the spleen removed with practically no loss of blood, except for a slight back oozing from the spleen

The patient did well following the operation His temperature gradually came down, and he was very comfortable and happy He looked better and felt better than before the operation On June 5 the wound was clean and solid

June 7 he began to have cramp-like abdominal pain of short duration, relieved by enemata The abdomen was soft and he was sleeping soundly The abdominal pain increased in frequency and severity and on June 11 the patient appeared to be really sick He was not relieved by enemata or by catheterization, and he began to vomit A flat tumor was felt over the symphysis The stomach was washed but only a few ounces of bile-stained fluid was obtained The abdomen was distended, soft to palpation, but everywhere tender

On June 12 the pulse rose to 150, and the patient was in very poor condition The abdominal pain was extreme, but the abdomen was soft Repeated enemata failed to bring gas results There was evidently intestinal obstruction Operation was decided upon, and under ether a seven-inch median incision was made with the escape of considerable free fluid, disclosing a blackened, distended small bowel This appeared to be gangrenous ileum due to mesenteric thrombosis The diseased bowel was removed, leaving a margin of safety of from four to six inches on either side During the division of the mesentery thrombic plugs were expressed from the mesenteric veins An end-to-end anastomosis was done

## CASE OF SPLENECTOMY

The patient made a short ether recovery but the pulse remained very rapid and of poor quality. Transfusion was considered, but no donor was available in time. The patient gradually failed and died on June 12, during the afternoon following the operation. No autopsy was allowed.

The blood examination on June 8 showed the hæmoglobin to have risen to 75 per cent. The white cells were 12,000 and the red cells were 4,800,000.

The pathological report upon the spleen on May 29 was as follows

Spleen 32 by 13 by 6 cm., smooth surface, section reddish with prominent trabeculae. There was an adherent thrombus at the opening of the splenic vein. Microscopical examination showed well marked follicles and vessels with a considerable area of rather hyaline connective tissue about them. The pulp of the spleen showed rather a proliferation of endothelial elements. In some sections the blood capillaries were distinctly enlarged and dilated. Diagnosis Hypertrophy (Signed) W F Whitney, M D

The pathological report upon the intestine removed on June 12 was as follows

Portion of the small intestine 3 metres 40 cm long, which is brownish-black and necrotic. The mesentery is very much thickened, and on section there are numerous veins filled with thrombi. Microscopical examination of sections taken from the mesentery shows the veins widely dilated by a thrombus and the enlarged portion of the mesentery filled with scattered areas of cells and extravasated blood. Diagnosis Venous thrombosis with infarction (Signed) H F Hartwell, M D

*Remarks*—I place upon record this case of splenic anaemia which died following splenectomy because it seems to me important to report such cases just at present when the therapeutic value of splenectomy is being discussed and experimental work is being done.

Interest centres in the fact that following a properly conducted splenectomy a thrombosis occurred in a vascular system not directly connected with the vascular system of the spleen. At the second operation the gangrene of the small intestine was found definitely localized and had occurred independently of any plugging thrombosis of the splenic vessels proximal to the ligatures placed at the time of the splenectomy.



## THE DIAGNOSIS OF APPENDICITIS IN EARLY TYPHOID FEVER \*

BY RANDOLPH WINSLOW, M D  
OF BALTIMORE, MD

THE appendix vermiformis is a vestigial organ which, like the tongue, "is an unruly evil, full of deadly poison" Its tendencies to evil are shown on so many occasions that it is somewhat noteworthy that it does not exhibit its malevolence in typhoid fever more frequently than appears to be the case Nevertheless, it is by no means an unimportant factor in the surgical complications of this disease While appendicitis undoubtedly may coexist with typhoid fever in any and all of its stages, either as a result of the invasion of the lymphoid structures of the appendix by the typhoid bacilli or from the ordinary intestinal and pyogenic organisms, my attention has been directed especially to the question of the diagnosis of appendicitis in the early days of typhoid fever and to the advisability of operating in such cases

The following case was the occasion of considerable chagrin to me at the time of its occurrence and served to call my attention to this subject

CASE I —L F, white female aged eighteen years, while at work on August 9, 1913, was taken suddenly with pain in the right side and headache Previous to this time she had been in good health On the tenth she was compelled to take to her bed and so continued until she entered the University Hospital on the thirteenth of the same month On admission her temperature was 102.6°, pulse 95, respiration 22 She had continuous pain in the right iliac region and tenderness over McBurney's point, with muscular rigidity She had had nausea and vomiting but no diarrhoea The tongue was somewhat coated, especially in the middle The liver and spleen were not palpable At this time the hæmoglobin was 100, and the leucocyte count 8,200 Widal reaction was not present The urine showed a slight ring of albumen, a few granular casts and pus cells, sugar and acetone, but no diacetic acid A diagnosis of appendicitis was made and laparotomy was done, under ether anæsthesia, on August 14 A right rectus incision was made and the appendix removed in the usual manner This organ was somewhat injected and slightly enlarged, but did not appear to be sufficiently affected to cause her symptoms The small intestines were reddened and the retroperitoneal glands

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\* Read before the American Surgical Association, June 9, 1915

## APPENDICITIS IN EARLY TYPHOID FEVER

enlarged and I suggested the probability of enteric fever as the cause of her symptoms rather than appendicitis. She subsequently ran a typical typhoid course, the Widal reaction becoming suggestive on the seventeenth and positive on the twentieth. She recovered and was able to leave the hospital in exactly one month from the time of her admission.

Three other cases of similar character were operated on by my colleagues at the University Hospital at about the same time, and they also serve to emphasize the difficulty of diagnosis in these conditions.

CASE II—S W, white male, twenty years of age, was taken suddenly with chilly sensations, on July 19, 1913. On the next day he again experienced chilliness and had several attacks of vomiting. He developed fever and entered hospital on July 24, five days subsequent to the onset. On admission his temperature was  $103^{\circ}$ , pulse 90 and respiration 25. He was distinctly ill, with an anxious facies and tongue heavily coated with a whitish-brown fur. No rose spots were present and the spleen was not palpable. There was no evident pain, but the abdomen was rather tender in all areas and deep pressure over the appendical region caused a distinct muscular spasm. On this date his leucocyte count was 10,000 and hæmoglobin 90 per cent. On July 25 his abdomen was opened. The appendix was congested but not acutely inflamed, while a general hyperæmic condition of the intestines was noted. The appendix was removed and the abdomen closed without drainage. The probability of typhoid fever was recognized, and the subsequent course of the case was typical of this disease, including a positive Widal reaction. He died from typhoid toxæmia on August 6, eleven days subsequent to the operation.

CASE III—H D, white female, aged sixteen years, entered University Hospital on July 6, 1913, complaining of pain in the right side of the abdomen, with rigidity and tenderness on pressure, temperature  $102.4^{\circ}$ , pulse 122, respiration 22. She was taken sick on July 4 with abdominal pain, headache and a stiff feeling in the abdomen. A diagnosis of acute appendicitis was made and an immediate operation was done. The abdomen was opened under ether anæsthesia, and a slightly inflamed appendix was removed. The cæcum and colon were also congested. A chain of much enlarged lymphatic glands was felt along the right side of the vertebral column. At this time the Widal reaction was negative. She subsequently ran a typical typhoid course and made a good recovery.

Blood examination showed polymorphonuclears 74 per cent, small mononuclears 22 per cent, large mononuclears 4 per cent

CASE IV —Miss E, hospital nurse, aged twenty-three years, was taken sick on December 3, 1912, with malaise, pain in back and slight fever. Subsequently the pain localized in the right iliac fossa, with tenderness on pressure, but without much rigidity. Widal was negative at this time and the leucocyte count about 8,000. Acute appendicitis was diagnosed and laparotomy done on December 12, 1912. The appendix was slightly congested but not materially inflamed, and there was a peculiar cyanosis of the small intestines. There was also considerable glandular enlargement in the mesentery but no free fluid in the peritoneal cavity. The appendix was removed and its mucous membrane was seen to be thickened, with a few superficial ulcerations. She ran a typical typhoid course and recovered in six weeks. Widal reaction was positive in the second week.

We have here four cases occurring in the same hospital at almost the same time and treated by several different surgeons. From the appearance of the appendices at the time of operation, and from the subsequent course of the cases, it is evident that unnecessary operations were done during the active period of a dangerous disease. Was this the result of lack of knowledge on the part of the operators, or of negligence in the examination of the cases, or are the difficulties in establishing a differential diagnosis real and these mistakes excusable?

The cases here reported are too few to draw definite conclusions from, but an analysis of the symptoms may at least be interesting and perhaps suggestive.

*Onset of the Disease* —Case I was taken suddenly ill, with headache and pain in the right side, while at work. She had been in good health up to this time. Case II appears to have had a general diffuse tenderness exaggerated on pressure in the appendical area upon admission to the hospital. Apparently the disease began five days previously with chilly sensations followed by fever, and not with pain. Case III was taken sick with abdominal pain, headache and a stiff feeling of the abdomen. There is no history of preceding fever. Case IV was taken with pain and slight elevation of temperature.

In three of these four cases pain appears to have been the symptom that first attracted the patients' attention and not fever.

Chilliness and fever certainly was the prominent feature of the onset of Case II.

In Case I the temperature on admission was 102.6°, four days after the onset, pulse 95.

## APPENDICITIS IN EARLY TYPHOID FEVER

In Case II temperature was  $103^{\circ}$ , pulse 90, five days after the onset

In Case III temperature  $102.4^{\circ}$ , pulse 122, two days after the onset

In Case IV temperature was about  $100^{\circ}$  when the patient took to bed

Headache was noted in two cases as one of the initial symptoms, and nausea and vomiting in two cases

The leucocyte count was 8,200, 8,000 and 10,000 in three cases, and in one case the polynuclears were 74 per cent, small mononuclears 22 per cent and large mononuclears 4 per cent, but the leucocyte count was not recorded

The hæmoglobin was 100 in Case I, 90 in Case II, and probably not determined in the other cases

On admission it is specifically stated that Case I had continuous pain in the right iliac region, with tenderness and muscular rigidity at McBurney's point

In Case II there was diffused abdominal tenderness with distinct muscular spasm on deep pressure over the appendical region

In Case III there was pain in right side of the abdomen, tenderness but not much muscular rigidity

In two cases it is recorded that the spleen was not palpable Diarrhoea was not a prominent symptom in any of these cases

In none of these cases was the Widal reaction positive at the time of the operation, but became so in each subsequently Rose spots also do not appear at such an early period of typhoid fever

In all these cases the appendix was somewhat congested, possibly thickened, but not acutely inflamed, while the large and small intestines were also more hyperæmic than normal

The mesenteric and prevertebral chains of glands were also markedly enlarged in most of the cases

I believe this mistaken diagnosis of appendicitis in early typhoid fever is by no means uncommon, and my purpose in presenting this communication is more for the purpose of eliciting information than for imparting it

I confess that I do not know how we can avoid this mistake I am aware that Dr Murphy lays down the rule that in appendicitis pain always precedes fever, while in these atypical typhoid cases fever always precedes pain I do not think we should accept this statement axiomatically In many cases it will be impossible to ascertain whether pain or fever was the initial symptom, and in some cases of typhoid fever pain appears to have been the first symptom to attract the patient's attention Indeed, Osler says enteric fever may be ushered in with pain in the abdomen and that "on account of pain in the right iliac fossa,

fever and constipation the diagnosis of appendicitis has been made and in two such cases at Johns Hopkins Hospital laparotomy was performed " I think it probable that some lesion of the appendix is present in these cases

The leucocyte count is probably the most reliable diagnostic sign, and it is usually low in typhoid fever and markedly increased in appendicitis, though at times there may be a low leucocyte count in serious and even fatal appendicitis

I think also there is less muscular rigidity and tenderness in these typhoid cases than in cases of genuine appendicitis Headache also is more common Another possible factor in the diagnosis may be the time of the year at which the cases occur, as three of the four cases here reported occurred in July and August, months in which typhoid is especially prevalent

In conclusion I think it is a very unfortunate occurrence to mistake a case of beginning typhoid fever, with abdominal pain, for appendicitis and to subject such a patient to an abdominal section This can only be avoided by a careful consideration of the history of the onset of the malady, to ascertain whether fever or pain was the initial symptom, whether the pain was sudden and severe or developed after prodromal symptoms of headache, malaise and fever If the abdomen is not markedly rigid, even though pain and tenderness in the right iliac fossa be present, and if the leucocyte count remains low, operation should be deferred until a clear diagnosis is reached

## TYPHOID PERFORATION

By JOHN H. GIBBON, M.D.

(Continued from page 408)

### CASE LXXXIII—*Perforation Operation Death Autopsy*

Male, white, laborer, aged twenty-five years, hospital No 3044, admitted December 29, 1906, on the seventh day of disease. He ran a moderately severe course until the seventeenth day, when he suddenly developed recurrent paroxysms of abdominal pain with chill, abdominal tenderness and rigidity, with flexed legs and thighs, with marked retraction of the abdomen, pinched anxious expression, shock, and elevated pulse and respirations with sudden 4-degree elevation of temperature, and relief to certain extent of symptoms between paroxysms of pain, except abdominal tenderness and slight rigidity. Pulse and respiratory rate remained increased. His Widal was positive on admission with 4600 leucocytes. He was seen by a surgeon 18 hours after the onset of pain. At this time his leucocytes were 8450. Operation 2 hours later, diffuse peritonitis was found with effusion of fecal matter into the cavity. Perforation, 2 mm in diameter, in the cæcum a few inches above the ileocæcal valve. Perforation was closed, the abdomen drained with gauze, and enteroclysis instituted after operation. Death 12 hours later. Autopsy. No other perforation found but diffuse peritonitis, swelling and deep ulceration of the lymph follicles, swelling of the mesenteric glands and acute splenic tumor.

### CASE LXXXIV—*Perforation Operation Recovery*

Male, white, junk dealer, aged twenty-four years, hospital No 3317, admitted January 23, 1907, on the eleventh day of disease, with a positive Widal and 8900 leucocytes. He ran a mild course from the time of his admission to the seventeenth day of the disease, when he developed sudden sharp recurrent paroxysms of pain with abdominal retraction, with thoracic breathing, lower abdominal rigidity, with tenderness more marked in left lower quadrant, and a 6-degree elevation of temperature from normal, with 25 per cent increase in respiratory rate and 30 per cent increase in pulse rate over the highest recorded for the same day. Two minutes' auscultation did not reveal any peristaltic sounds. No change in liver dulness. Leucocyte count 3 hours before operation 6600. Marked tenderness on rectal examination. Operation, ethyl-chloride-ether anæsthesia, 5 hours

after onset of pain, some soiling of peritoneal cavity with perforation in ileum, location not stated, and pin-head in size Perforation sutured, abdomen flushed with salt solution, gauze drainage, uneventful recovery

CASE LXXXV—*Perforation Operation Death Autopsy*

Male, white, fireman, aged twenty-seven years, hospital No 3424, admitted February 1, 1907, on the sixteenth day of the disease, with a suggestive Widal, 2900 leucocytes, and a severe infection On the eighteenth day he developed recurrent paroxysms of abdominal pain (slept for 15 minutes between paroxysms), had a chill, was nauseated, his pulse jumped from 100 to 120 without change in respiratory rate, his temperature was elevated 3 degrees over previous temperature, marked abdominal tenderness over lower quadrants, slight rigidity over the right lower quadrant, decreased liver dulness, audible abdominal breath sounds, no peristaltic sounds heard, leucocyte count 4 hours after onset of pain 3100, 5 hours after, 5500, 8 hours after, 6900 Operation, 10 hours after onset of pain, small perforation (pin-head in size) found in ileum 18 inches above the ileocæcal valve Perforation closed, abdomen irrigated, gauze and rubber tube drainage, Murphy treatment instituted Death two days after operation Autopsy General peritonitis, no other perforation

CASE LXXXVI—*Perforation (on admission) Operation Recovery*

Male, white, tailor, aged thirty-eight years, hospital No 3527, admitted February 11, 1907 Patient had been sick for three weeks with symptoms of typhoid fever There was no record of leucocytes or Widal in this case On the day before admission he had taken a large dose of cascara Seven hours before admission to the hospital he was seized with sudden severe abdominal pain and had a chill He was referred to the hospital as a case of acute appendicitis On admission he had marked generalized abdominal pain with considerable distention, tenderness and rigidity No peristaltic sounds were heard, but the breath sounds were audible over the entire abdomen, liver dulness was absent to the mid-axillary line, and rectal examination revealed marked tenderness His temperature on admission was 102°, respirations 28, and his pulse 106 Judging from the patient's history the previous course of his typhoid had not been severe Diagnosis of typhoid perforation was made and operation done soon after General peritonitis with a perforation in the ileum 3 mm in diameter and 3 inches above the ileocæcal valve which was sutured, abdomen irrigated, and drained with gauze Enteroclysis given after operation Recovered and was discharged from the hospital April 4, 1907

## TYPHOID PERFORATION

### CASE LXXXVII—*Perforation Operation Death Autopsy*

Male, teamster, aged forty years, hospital No 3563, admitted February 14, 1907, with a severe infection, on the twelfth day of disease, with a positive Widal and 7200 leucocytes. On the twenty-first day he had a severe chill with moderate abdominal pain after the chill, his pulse jumped from 92 to 140, slight abdominal tenderness, and slight rigidity of the right rectus. His abdominal distention, which he had had since his admission, became increased and his temperature rather high, but remitting. Immediately after the chill he had a 5-degree elevation of temperature. His liver dulness was impaired, but not obliterated, and his respiratory rate increased. At this time he was seen by the attending physician and a surgeon, and the diagnosis of perforation was in doubt. Owing to his extremely bad condition and an existing bronchopneumonia, operation was deferred. His leucocyte count at the onset of pain was 4400, 8 hours later, 7200, and 21 hours later, 8600. Operation under ethyl-chloride-ether anæsthesia 21 hours after onset of pain. General peritonitis was found with a perforation, pin-head in size, in ileum 12 inches above the ileocæcal valve. It was sutured and the abdomen drained. Patient's condition became worse and he died 15 hours after operation. Autopsy showed general peritonitis and another perforation one foot above the one found at the time of operation.

### CASE LXXXVIII—*Perforation Operation Recovery*

Female, white, housework, aged thirty-seven years, hospital No 167, admitted April 4, 1907, on the tenth day of a marked infection, with a positive Widal and 6750 leucocytes. On the thirteenth day abdomen became distended, with slight abdominal pain, and remained so until the seventeenth day, when she complained of sudden severe abdominal pain in the right lower quadrant with marked tenderness and rigidity of the right rectus. This was accompanied by vomiting. The pulse rate increased 20 per cent over the highest previous count for the same day, respirations were increased, and there was an immediate drop of temperature ( $2\frac{1}{2}$  degrees) at the onset of pain with a subsequent elevation of 4 degrees. The leucocyte count just before operation was 14,500. Operation, ethyl-chloride-ether anæsthesia, 5 hours after onset of severe pain, right rectus incision, perforation found, pin-head in size, in the cæcum near the base of the appendix. It was closed and the abdomen drained with gauze. After the operation she continued a mild febrile course for 22 days but made an uneventful recovery and was discharged cured 52 days after operation.

### CASE LXXXIX—*Perforation (on admission) Operation Death Autopsy*



Male, white, aged thirty years, hospital No 4336, admitted April 22, 1907 This patient had been sick for about 17 days before admission to the hospital He seemed to be suffering from a severe infection and there is no record of Widal or leucocyte count in this case Two days before admission he was seized with severe abdominal pain and vomiting, which had been worse during the 24 hours previous to admission Was very constipated Pain began in the right iliac fossa and then became generalized Had diarrhoea for several days before admission with one intestinal hemorrhage The liver dulness was obliterated and he presented the picture of diffuse peritonitis At operation, soon after admission, general peritonitis was found with a perforation 3 mm in diameter in the ileum 3 inches above the ileo-cæcal valve It was sutured, the abdomen irrigated with salt solution, and drained with gauze He died 5 hours after operation Autopsy showed general peritonitis, no other perforation, bronchopneumonia and pulmonary tuberculosis

CASE XC—*Perforation Operation Death*

Male, white, engineer, aged thirty-three years, hospital No 785, admitted June 17, 1907, on about the seventh day of a severe typhoid with pronounced toxæmia, Widal and admission leucocytes not recorded About the sixteenth day of the infection he had a severe chill with marked abdominal pain and great tenderness and rigidity over the lower half of the abdomen His liver dulness was obliterated and he had a severe hemorrhage just before the onset of pain He also complained of vesical and rectal pressure pain He was operated upon a few hours later and a large perforation found in the ileum, near the cæcum, with general peritonitis The perforation was sutured, the abdomen drained with gauze after irrigation, and death 36 hours after operation, probably from peritonitis No autopsy (The temperature, pulse, and respiratory changes in this case were not given because the temperature chart had been lost)

CASE XCI—*Perforation Operation Recovery*

Male, white, laborer, aged thirty-three years, hospital No 1741, admitted September 16, 1907, on the eleventh day of the disease, with a moderately severe infection, Widal negative, and leucocytes 9100 At the time of admission he complained of slight pain and tenderness in the right iliac fossa and his abdomen was distended On the twelfth day of disease he developed sudden severe cramp-like pain in the right lower quadrant of the abdomen, had two or three paroxysms at ten- or fifteen-minute intervals, abdomen became very tender and rigid, had a chill, pulse was increased from 100 to 124, and there was a 4-degree temperature elevation His leucocytes at the onset of pain were 9250, one hour

## TYPHOID PERFORATION

later 8900 Operation two hours after onset of pain, ethyl-chloride-ether anæsthesia, right rectus incision Much fecal matter and fluid found in peritoneal cavity with two perforations, one in ileum (location not stated), one-fourth of an inch in diameter, and the other in the cæcum "half the size of a penny" Both closed with linen thread suture, abdomen flushed with salt solution, and drained with gauze Murphy treatment instituted Temperature practically normal on tenth day after operation, except for an occasional slight rise afterwards Developed fecal fistula fourth day after operation which persisted, but in spite of this he continued to gain weight and was discharged on the fiftieth day after operation with a small fistula, which required dressing once in 24 hours

### CASE XCII—*Perforation Operation Recovery*

Male, white, tailor, aged twenty years, hospital No 2154, admitted October 24, 1907 Was admitted with a history of having been sick for four days with general malaise, headache, and "ill feeling" On admission he had a positive Widal, 13,350 leucocytes, and was considered a case of ambulatory typhoid fever On admission his pulse was 108, respirations 32, temperature 101°, and he had been in bed only three days When he came to the hospital he complained of having had severe pain in his abdomen for three days He had considerable distention, generalized rigidity with marked tenderness in the left lower quadrant Operation 16 hours after admission, ethyl-chloride-ether anæsthesia, right rectus incision On opening the peritoneum gas and much free purulent fluid with fecal odor escaped Small perforation found in ileum, location not stated, which was closed, the abdomen was irrigated, and the wound closed without drainage Temperature was normal the third day after operation, he had slight fever from the seventh to the tenth day after the operation, when it was discovered that he had a slight wound infection After this he made an uneventful recovery and was discharged the fifty-first day

### CASE XCIII—*Perforation Operation Death Autopsy*

Female, white, saleslady, aged seventeen years, hospital No 2281, admitted November 5, 1907, on the eighth day of a severe infection, with a very suggestive Widal and 4150 leucocytes Abdomen was distended from the time of admission and she had several profuse hemorrhages, both before and after her admission, with slight diarrhœa On the sixteenth day of disease she had a chill with sudden sharp, cramp-like umbilical pain, abating after the insertion of a rectal tube Marked abdominal tenderness with generalized rigidity She lay on her side with legs and thighs flexed, with rectal tenesmus, with moderate distention, and with

marked pain on palpation. Pulse previous to onset of pain was 108, it jumped to 140, respirations were increased 40 per cent, with a sharp 3-degree temperature elevation. Leucocytes at the onset of pain were 7800, two hours later, and a half hour before operation, 4400. Operation, ethyl-chloride-ether anæsthesia, right rectus incision, considerable turbid fluid in the abdomen with plastic exudate about the site of perforation which was found in the ileum, 14 inches above the ileocæcal valve, size not stated. Two other deep ulcers were invaginated. The abdomen was drained with gauze. On the fourth day after operation she developed a right-sided pneumonia, on the tenth day it became bilateral, and she died on the eleventh day after operation. The abdominal condition up to this time had been satisfactory. Autopsy showed double lobar pneumonia, cloudy swelling of the heart and liver, slight plastic peritonitis about the site of perforation, and no secondary perforation.

CASE XCIV—*Perforation Death Autopsy*

Male, white, miller, aged thirty-seven years, hospital No 2734, admitted December 20, 1907, on the fifteenth day of a severe infection, with a positive Widal and 8350 leucocytes. Patient was very sick and stupid from the time of his admission, abdomen considerably distended. On the eighteenth day had a chill, abdomen became more distended, legs and thighs flexed, there was slight generalized tenderness on palpation, the abdomen was slightly resistant, and there was dullness on percussion in the right flank. After the chill he had a 6-degree temperature elevation, his pulse became so rapid and weak that it could not be counted, respirations jumped from 22 to 40, and he seemed in a state of extreme shock. He reacted very poorly to stimulation and subsequently collapsed and died 18 hours after chill, on the nineteenth day of disease. Autopsy showed general peritonitis with a perforation, 1.5 cm in diameter, in the ileum 50 cm from the ileocæcal valve, acute bronchopneumonia with a stricture of the ureters and a double hydronephrosis.

CASE XCV—*Perforation Operation Death*

Male, white, laborer, aged forty-five years, hospital No 3201, admitted February 2, 1908, on the eighth day of a severe infection, with a positive Widal and 9650 leucocytes. After his admission he had slight diarrhoea with slight abdominal distention up to the twenty-ninth day, with moderately high fever (103 to 104). On the twenty-ninth and thirtieth days he had 3 distinct attacks of cramp-like abdominal pain. The first attack was subsequent to a 13-ounce hemorrhage, after which he was given heavy doses of opium. Fifteen hours later he had a second attack of pain with increasing distention, moderate generalized tenderness, with seem-

ing slight improvement in condition and abdominal signs between attacks of abdominal pain. Twenty-four hours after the first attack of pain he had the third attack which was severe, pain more marked in the left lower quadrant with increasing tenderness, diminished peristalsis, and obliterated liver dulness. His pulse immediately became much accelerated after the first attack of pain, a 30 per cent increase over the highest previous count, with a proportionate respiratory increase. With the first attack of pain there was an immediate drop in temperature with a subsequent rise, after which it became slightly fluctuating. His leucocyte count was 10,250, 24 hours after onset of pain. The circulatory and respiratory disturbance in this case seemed out of proportion to the local abdominal signs and symptoms. Operation 30 hours after onset of pain under ethyl-chloride-ether anæsthesia. On opening the peritoneum it was found filled with purulent fluid and blood, with 3 perforations in the ileum 24 to 36 inches from the ileocæcal valve, varying in size from that of a dime to a quarter of a dollar. This loop of intestine was brought into the wound, surrounded with gauze, and a fistula made. The shock of the operation was severe. Death 12 hours after operation without good reaction.

#### CASE XCVI—*Perforation Operation Death*

Male, white, laborer, aged thirty years, hospital No 3336, admitted February 14, 1908, on the fourteenth day of a moderate infection, positive Widal, and 2350 leucocytes. After his admission he had slight diarrhoea with abdominal distention. On the twenty-first day he complained of slight abdominal pain which persisted for 12 hours, when he had a severe attack of abdominal pain with accelerated pulse and respirations. His temperature immediately dropped 2 degrees with a subsequent 4-degree elevation. With the onset of the slight abdominal pain he also had slight persistent tenderness and increasing distention, and with the onset of the severe pain he had marked tenderness and rigidity, which was more pronounced in the left lower quadrant, peristalsis was diminished, liver dulness partially obliterated, and his leucocytes two hours before operation were 4700. Operation, ethyl-chloride-ether anæsthesia, two hours after onset of severe pain. A small perforation was found in the ileum 24 inches above the ileocæcal valve—it was sutured, the abdomen drained with gauze, and Murphy treatment instituted. Did well for 2 days, when he developed lobar pneumonia and died the third day after operation.

#### CASE XCVII—*Perforation Operation Recovery*

Male, white, street cleaner, aged nineteen years, hospital No 135, admitted February 14, 1908, on the sixteenth day of a severe infection, with a positive Widal and 4800 leucocytes. The symp-

toms in this case on which the diagnosis of perforation was based were not recorded. Perforation occurred on the twenty-first day, operation soon after onset of perforative symptoms, ethyl-chloride-ether anæsthesia, right rectus incision. Free purulent fluid found on opening the peritoneum, with plastic peritonitis about the cæcum and coil of intestine containing perforation, which was about the size of a lead pencil, and in the ileum 18 inches above the ileo-cæcal valve. It was sutured, the abdomen irrigated, and drained with gauze. Murphy treatment instituted. Stood the operation fairly well and on the seventh day the gauze drain was removed and a profuse fecal discharge followed. The patient continued to do well. The fecal fistula persisted for three months, when it closed and he was discharged cured. Other than this his recovery was uneventful.

CASE XCVIII — *Perforation Operation Death*

Male, white, laborer, aged twenty-six years, hospital No 3380, admitted February 17, 1908, on the seventh day of a mild infection, with a positive Widal and 5250 leucocytes. On the twentieth day he complained of slight abdominal pain, increasing abdominal distention, with a slight tenderness in the left half of the abdomen, which persisted for 6 hours, when he had an attack of severe pain, sudden in onset, with accelerated pulse and respirations, nausea, lessened peristalsis, diminished liver dulness, and increasing abdominal tenderness and rigidity. His leucocyte count 12 hours before operation was 5550. Operation, ethyl-chloride-ether anæsthesia, perforation found, pin-head in size, in the ileum 4 cm above the ileo-cæcal valve. It was closed and the abdomen drained with gauze. Death at the end of the third day. Autopsy. Diffuse peritonitis, no secondary perforation.

CASE XCIX — *Perforation Death Autopsy*

Male, white, laborer, aged thirty-five years, hospital No 3905, admitted March 30, 1908, on the sixth (?) day of a severe infection, with a negative Widal and 11,700 leucocytes. This patient, a well-developed Italian, complained of being sick for 6 days before admission with cough, chill, expectoration, pain in the chest, and vomiting. His temperature on admission was 104°, pulse 120, respirations 36. The abdomen was full, soft, and not tender. On the seventh day (day after admission) he developed signs of pneumonia at the left base. The abdomen remained full and soft and the spleen not palpable. At 11 P M on the seventh day he was visited by the resident physician, who found him with Cheyne-Stokes breathing, the dyspnoæic periods lasting about ten seconds, with four or five shallow respirations, and the apnoæic periods were about 15 seconds on the average. The pulse ranged from 124 to 146, respirations from 28 to 40, and there was marked cyanosis.

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of the face and hands. A phlebotomy was done and 15 ounces of blood taken, after which 21 ounces of normal salt solution were given intravenously, which seemed to relieve him. The respirations became regular, cyanosis cleared up, and the pulse improved. Soon after this the abdomen became greatly distended with partial obliteration of liver dulness and great restlessness. On the morning of the eighth day he sat up in bed, suddenly dropped over, and died, vomiting at this time. His pulse had become more irregular after 2 A.M. and he voided 27 ounces of urine in the previous 35 hours, which contained much albumen and many granular casts. Autopsy showed hemorrhagic infiltration of intestines with typhoid ulceration of the ileum and with a perforation 2 mm. in diameter in the ileum 18 cm. above the ileocecal valve. Multiple thrombosis of the portal vein, fibrinopurulent pleurisy with effusion, obliterative pericarditis, chronic diffused nephritis, cloudy swelling of the liver, bronchopneumonia, and peritonitis.

### CASE C—*Perforation Death Autopsy*

Male, white, brick-layer, aged forty-five years, hospital No. 3906, admitted March 30, 1908, with prodromal symptoms extending over an indefinite period of a few weeks. Three days prior to his admission he developed acute abdominal pain with distention and tenderness. Before this his chief complaint had been cough, without expectoration, labored breathing, and profuse sweating. On admission he seemed very ill, pulse was 120, respirations were 60, his temperature was 102, and he had marked abdominal distention. He was seen by a surgeon who thought he had a pyopneumothorax and advised thoracic aspiration, which was done and 200 c.c. of pus withdrawn. The abdomen at this time was tense, rigid, and distended. The left chest was clear throughout. A few hours later he began to vomit, became rapidly worse, and died 18 hours after admission. Autopsy showed general fibrinopurulent peritonitis, ulceration of the ileum with perforation 2 cm. in diameter 100 cm. above the ileocecal valve, cloudy swelling of the liver and kidneys, acute splenic tumor, acute pleurisy with purulent effusion, acute bronchopneumonia.

### CASE CI—*Perforation Operation Death Autopsy*

Male, white, student, aged fourteen years, hospital No. 149, admitted April 6, 1908, with a positive Widal, 3950 leucocytes, and on the fifteenth day of moderate infection. The disease was uncomplicated up to the twenty-eighth day, when he developed recurring attacks of sharp abdominal pain, which at first were localized to the right lower quadrant, but later seemed almost as severe in the left lower quadrant. With the onset of pain he had a severe chill with a 4-degree elevation of temperature, 30 per cent increase in pulse rate, 40 per cent increase in respiratory

rate, increasing abdominal tenderness and rigidity, diminished peristalsis without much apparent change in liver dulness, abdomen distended with rapidly increasing signs of peritonitis. His leucocytes one week before the onset of pain were 5500, two hours after the onset of pain, 5700, 9 hours after the onset of pain, 2650. During this time the patient's condition was becoming more grave. Operation 12 hours after onset of pain, ethyl-chloride-ether anæsthesia, right rectus incision. The abdomen was filled with yellow turbid fluid with adhesions between the coils of intestine and much lymph. There was a free escape of pus between the coils of intestine and mesentery about the cæcum. No perforation was found. No evident rupture of the mesentery gland. The abdomen was drained with gauze. Patient died 9 days later. A partial autopsy was done, several small perforations were found in the cæcum with extensive ulceration of the ileum and cæcum.

#### CASE CII—*Perforation Operation Recovery*

Male, white, student, aged ten years, hospital No 150, admitted April 4, 1908, on the twenty-second day of a moderate infection, with a positive Widal and 6600 leucocytes. He continued a moderate febrile course until the thirty-third day, when he was seized with sharp abdominal pain in the left lower quadrant (recurring attacks), with a severe chill, marked acceleration of pulse and respirations with great tenderness over the left lower quadrant, increasing muscular rigidity, and considerable abdominal distention. There was almost entire relief from pain and tenderness between sharp attacks. Sharp elevation of temperature and liver dulness not obliterated. Leucocytes 6 hours after the onset of pain were 5750, 10 hours after, 4900. At this time the abdomen was opened, ethyl-chloride-ether anæsthesia, through a right rectus incision. Opening the peritoneum there was a free escape of turbid fluid, the intestines were covered with plastic lymph, and a pin-head perforation was found in the ileum 12 inches above the ileocæcal valve. It was closed with silk sutures and another deep pre-perforative ulcer was invaginated. Gauze drainage instituted. Fever continued 8 days after operation with a subsequent 10-day relapse, beginning on the twentieth day after operation. He made an uneventful recovery after this and was discharged cured on the ninetyeth day after operation.

#### CASE CIII—*Perforation Death Autopsy*

Male, white, laborer, aged forty years, hospital No 4014, admitted April 8, 1908, on the ninth day of a severe infection, with a positive Widal and a positive blood culture for typhoid bacilli and a leucocyte count of 4550. Patient was very sick and profoundly toxic with slight diarrhœa and considerable abdominal

## TYPHOID PERFORATION

distention from the time of his admission. On the nineteenth day he developed signs of pneumonia, on the twenty-first day he had a chill, accelerated pulse and respirations, a 3-degree temperature elevation, but did not complain of pain or tenderness on interrogation. At this time he was profoundly toxic and almost stuporous, his abdomen becoming more distended, soon became delirious, and died on the twenty-third day without complaining of any abdominal discomfort at any time. Autopsy showed bronchopneumonia, cloudy swelling of heart, liver, and kidneys, general peritonitis, and typhoid ulceration of the ileum with a pin-head perforation in the ileum, 7 cm. above the ileocaecal valve.

### CASE CIV—*Perforation Operation Death*

Male, white, laborer, aged thirty-three years, hospital No 683, admitted June 5, 1908, on the tenth day of a severe typhoid, with a negative Widal and 7000 leucocytes. On the twenty-second day suddenly seized with severe pain, stitch-like in character, about the umbilicus. His pulse and respirations were very much accelerated, his pulse becoming so weak that an accurate count could not be made. Twelve hours later he had another severe attack of pain, again producing circulatory collapse with generalized tenderness and rigidity and increasing signs of peritonitis. His leucocytes at the onset of pain were 3750, 24 hours later, 4850. A day or so previous to the onset of his abdominal symptoms he had diarrhoea with one profuse intestinal hemorrhage. His temperature after the first attack of abdominal pain became remitting in character. Operation, which had been advised early, was refused until 30 hours after the onset of pain. Under ethyl-chloride-ether anaesthesia the abdomen was opened through a right rectus incision, general peritonitis was found with two perforations about a half an inch apart, one-eighth of an inch in diameter, in the ileum 7 inches above the ileocaecal valve. They were invaginated, the abdomen irrigated and drained with gauze. Died 12 hours later. No autopsy.

### CASE CV—*Perforation Operation Recovery*

Male, white, painter, aged eighteen years, hospital No 1285, admitted July 27, 1908, on the ninth day of a severe infection, with a very suggestive Widal and 5450 leucocytes. He had slight diarrhoea with considerable toxæmia. On the sixteenth day he developed sudden severe, cramp-like pain in the right lower quadrant with marked acceleration of the pulse and respirations, pulse 80 to 120 and very weak, respirations 24 to 40 with cyanosis and with tenderness and rigidity of the lower abdomen, most marked in the right iliac fossa. At the onset of pain his temperature dropped to normal, with a sharp 6-degree rise 3 hours later. Operation was done 3 hours after the onset of pain, abdo-



men opened under local anæsthesia and the operation concluded under ether anæsthesia. There was considerable soiling of the peritoneum and a "shot-like" perforation was found in the ileum 6 inches above the ileocæcal valve. It was closed, the abdomen was irrigated, and drained with gauze. During the next day he had 5 intestinal hemorrhages and developed a parotitis, but the abdominal condition continued satisfactorily. The temperature had gradually reached normal on the twenty-first day after operation, the wound had healed five weeks after operation, and he was discharged cured.

CASE CVI—*Perforation Operation Death Autopsy*

Female, white, housework, aged forty-eight years, hospital No 1717, admitted September 6, 1908, on the seventh day of a severe typhoid, positive Widal, and 7200 leucocytes. On the ninth day she complained of slight abdominal pain for 3 days, with this she had slight tenderness and a little muscular rigidity but there was no perceptible change in her general condition. On the twelfth day the pain suddenly became very severe, she had a chill, marked acceleration of the pulse which became almost imperceptible, vomited once, and had marked tenderness and rigidity in the left lower quadrant, which soon became generalized. There was much shock, and her temperature at the onset of these symptoms dropped 2 degrees with a quick subsequent  $3\frac{1}{2}$ -degree elevation. Leucocytes two hours before operation were 7000. Operation was done 4 hours after the onset of symptoms. There was considerable soiling of the peritoneal cavity and a perforation an eighth of an inch in diameter was found in the ileum 15 inches from the ileocæcal valve. The abdomen was irrigated, gauze drainage established. Patient did well for two days, condition greatly improving, and there was no abdominal distention or tenderness. On the third day after operation complained of abdominal pain, and the abdomen was distended. On the fourth day after operation she had 3 intestinal hemorrhages totalling 26 ounces, and died soon afterwards. A partial autopsy was done, the original perforating ulcer had sloughed and there was another perforation near this. There was diffuse peritonitis and the abdominal cavity was filled with blood and intestinal contents.

CASE CVII—*Perforation Operation Death Autopsy*

Male, colored, coal heaver, aged twenty-three years, hospital No 2025, admitted October 4, 1908, on the twenty-first day of a moderate infection, with a negative Widal and 6200 leucocytes. The patient had diarrhœa and slight abdominal distention from the time of admission. On the thirtieth day he developed slowly increasing abdominal pain with remissions in its severity from time to time, but each recurring attack being more severe. With

this was considerable tenderness in the right lower quadrant with rigidity of the right lower rectus. Owing to the frequent attacks and colicky character of his pain without any marked change in his general condition for the first two days, it was thought that he had an appendicitis. At the end of 48 hours he had vomited once and at this time his rigidity and tenderness had become more diffuse and he had persistent hiccough. During the first 24 hours operation had been advised for appendicitis, but had been refused. His pulse after the first 24 hours became accelerated and he had a slight chill. At the onset of pain he had 9400 leucocytes, and just before operation he had 21,000. He was operated upon 52 hours after the onset of pain. A general purulent peritonitis was found with a perforation 8 mm in diameter in the ileum 18 cm from the ileocæcal valve. It was closed, the abdomen was irrigated and drained with gauze. Enteroclysis with the patient on the right side and head of the bed elevated. Death 12 hours later. Autopsy. Bronchopneumonia, general purulent peritonitis with two other perforations, one 7 mm in diameter in the ileum 40 cm above the ileocæcal valve and another pin-point in size 1 cm above the ileocæcal valve.

#### CASE CVIII—*Perforation Operation Recovery*

Male, white, barber, aged twenty-eight years, hospital No 2100, admitted October 11, 1908, on the twelfth day of a mild infection, with a suggestive Widal and 4650 leucocytes. On the fourteenth day he had a severe attack of pain in left lower abdomen, he vomited once after taking milk just previous to the onset of pain, there was no rigidity, but moderate persisting tenderness in the left lower quadrant. There was slight distention of the abdomen but no noticeable change in his general condition. Peristalsis was diminished and there were audible abdominal breath sounds. Liver dulness was obliterated to the anterior axillary line. Leucocytes 6300 just before operation, which was done under ethyl-chloride-ether anæsthesia 12 hours after the onset of pain. There was marked effusion of fluid and intestinal contents in the peritoneal cavity with diffuse plastic peritonitis. A pin-head perforation was found at the ileocæcal juncture and another one-sixteenth of an inch in diameter in the ileum  $2\frac{1}{2}$  feet above the ileocæcal valve. Both were closed with purse-string sutures. The abdomen was irrigated and the wound closed without drainage. Murphy treatment instituted. Fever continued after operation and on the eighth day the wound was dressed and found infected. There was also a bulging mass at the right costal margin. This seemed to communicate with the upper end of the incision and on opening it considerable fecal matter escaped, a fecal fistula discharged freely for several days and the temperature dropped to

normal Subsequent to this he developed a large pelvic abscess which was opened and drained through the rectum He was discharged 38 days after the operation cured

CASE CIX—*Perforation Operation Death Autopsy*

Male, white, farmer, aged nineteen years, hospital No 3085, admitted January 4, 1909, on the twenty-first day of an ambulatory typhoid, with a positive Widal and 8900 leucocytes On admission temperature was  $103^{\circ}$ , pulse 108, respirations 28 Thirty-six hours before admission he had acute sudden abdominal pain and vomiting After entering the hospital he complained of abdominal pain and tenderness, both recti were rigid, he vomited several times, and movable dulness was noted in his flank Twenty-four hours later his abdomen was opened under local anæsthesia and a diffuse suppurative and plastic peritonitis found, the appendix and cæcum being adherent A 5 mm perforation was found 4 inches above the ileocæcal valve, the appendix was acutely inflamed and was removed The perforation was not closed but brought into the wound and surrounded with gauze packs The abdomen was irrigated and drained Patient died 30 hours after operation Autopsy revealed diffuse peritonitis without any other perforation

CASE CX—*Perforation Operation Death*

Male, white, business man, aged sixty-one years, hospital No 3875, admitted March 8, 1909, probably in the third week of the disease In the first part of his illness had an obstinate constipation but later a very foul and offensive diarrhœa On or about the twenty-first day of his illness he was awakened with sharp abdominal pains which disappeared rather quickly Two and a half hours later he had another violent attack of pain, but within an hour was perfectly comfortable Temperature had dropped from a  $101^{\circ}$  to normal and his pulse at this time was 96 He had voided urine and had had a slight bowel movement after the onset of pain He had no marked rigidity but was distinctly tender over the right lower quadrant His leucocytes were 8400 Four hours later the tenderness was much less marked and, owing to his comfortable and good condition (no opiate having been given), the attending surgeon thought it advisable to defer operation, feeling that perforation had not occurred Four hours later his tenderness had increased but the patient was quite comfortable and lying on his side Operation at that time was urged, but he was not operated upon until 5 hours later, or 18 hours after the onset of his first pain Under morphia-chloride of ethyl anæsthesia the abdomen was opened through the right rectus muscle, there was an escape of brownish fluid, a small perforation was found 3 inches from the cæcum which was closed with catgut and

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linen thread suture. Another ulcer threatening perforation was also inverted. The appendix was normal and no other perforation was found. The pelvis and kidney pouch were drained with gauze, patient placed in the Fowler position and Murphy treatment instituted. The patient died 5 days later, probably from toxæmia, without further signs of peritonitis. No autopsy.

### CASE CXI—*Perforation Death Autopsy*

Male, white, waiter, aged thirty-four years, hospital No 3957, admitted March 16, 1909, on the ninth day of a very severe illness, with a positive Widal, 17,300 leucocytes and his blood culture showing a pure growth of typhoid bacillus. This patient was profoundly toxic and delirious from the time of admission, his abdomen was distended and he had diarrhoea, temperature was high, his pulse was 120 or more from the time of his admission. On the sixteenth day he vomited a large quantity of brown liquid, suddenly collapsed and died shortly afterwards. Autopsy. Peritonitis, cloudy swelling of heart, liver and kidneys, acute splenic tumor, congestion of the lungs, typhoid ulceration of the ileum with pin-point perforation in the ileum, near the ileocæcal valve. Perforation in this case was not diagnosed and probably not suspected.

### CASE CXII—*Perforation Operation Death Autopsy*

Male, white, conductor, aged twenty-two years, hospital No 480, admitted May 13, 1909, on the sixth day of a severe infection, with a positive Widal and 5900 leucocytes. He suffered abdominal distention and marked diarrhoea from the time of his admission. On the nineteenth day he complained of abdominal pain, considerable tenderness and rigidity with a great deal of abdominal distention, and obliteration of the liver dulness. At the end of 12 hours he then developed very sudden and very severe pain with marked acceleration of the pulse, shock, and circulatory collapse with increased tenderness and rigidity of the abdomen. Operation, ethyl-chloride-ether anæsthesia, 14 hours after the onset of the first pain. On opening the peritoneum there was much purulent fluid with lymph over the intestines. A perforation 15 mm in diameter was found in the ileum 8 inches above the ileocæcal valve. This was closed, another deep ulcer invaginated, the abdominal cavity irrigated and drained with gauze. Death 2 hours later. Autopsy. General peritonitis, bronchopneumonia, chronic pulmonary tuberculosis, and another perforation, pin-head in size, in the ileum near the ileocæcal valve.

### CASE CXIII—*Perforation Operation Death*

Male, white, laborer, aged thirty-eight years, hospital No 1623, admitted August 30, 1909, on the fifteenth day of an ambulatory typhoid, positive Widal and 10,100 leucocytes. This patient

had been sick for two weeks with malaise and headache, but did not consider himself very sick until 30 hours before admission, when he suddenly developed acute abdominal pain with a great deal of "soreness" On admission the patient was in very poor condition, pulse was rapid, weak, and of poor quality, he was cyanotic, his abdomen was distended with generalized tenderness and rigidity, and he presented the usual picture of a diffuse peritonitis Operation was done soon after admission under ethyl-chloride-ether anæsthesia On opening the peritoneum a general peritonitis was found with effusion of the intestinal contents into the peritoneal cavity and two perforations, one was "small" and found in the ileum near the ileocecal juncture, the other was as large as the tip of a finger and was in the last portion of the jejunum This portion of the intestine was brought into the wound, surrounded with gauze, and a fistula operation done after the method employed by Hays The wound was drained with gauze and he did well for 3 days after operation, when he had another severe attack of abdominal pain with collapse and death in a few hours It was thought that he had another perforation but no autopsy was done

CASE CXIV—*Perforation Operation Death*

Male, white, student, aged eleven years, hospital No 3147, admitted January 14, 1910, on the tenth day of a severe infection, with a positive Widal and 6950 leucocytes This patient had 9 small hemorrhages from the tenth to the thirteenth days and during this time he was kept deeply under the influence of opium On the twelfth day considerable abdominal tenderness and rigidity were noted, but without complaint of pain Up to that day his pulse had not been recorded above 108, which was just after a 6-ounce hemorrhage Later in the day he had another 6-ounce hemorrhage and his pulse increased to 144 with increased abdominal tenderness and rigidity and gradual failure in his general condition Leucocytes, 4900 Operation under ethyl-chloride-ether anæsthesia on the third day after the onset of tenderness and rigidity, 5 perforations were found, all leaking fecal material, and within the last 6 or 7 inches of the ileum The largest was 1.5 cm in diameter, the others were smaller This section of the bowel was brought into the wound, surrounded with gauze, and the perforations were not closed Death 3 days later It was thought that death occurred from toxæmia, but no autopsy was done

CASE CXV—*Perforation Death Autopsy*

Female, white, coat-maker, aged thirty-five years, hospital No 3701, admitted February 28, 1910, on the ninth day of a moderately severe infection, with a positive Widal and 8650 leucocytes

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This patient had reached the sixteenth day without complications, her temperature had gradually fallen, and it looked as if she was nearing convalescence, when she had a severe chill with a rapid rise in pulse rate, 102 to 130, respirations 28 to 42, and a 4-degree elevation of temperature with acute sudden abdominal pain, more marked in the right iliac fossa, with tenderness and rigidity. She vomited twice, peristalsis was diminished and her leucocytes after the onset of pain were 7650, and there was also evidence of free fluid in the abdominal cavity. On the following day pain, tenderness and rigidity had increased, pulse was rapid and weak, frequent vomiting occurred and death took place rather suddenly 48 hours after the onset of pain. Autopsy. Acute general purulent peritonitis with a 7 mm perforation in the ileum 4 cm above the ileocaecal valve with marked ulceration of the ileum.

### CASE CXVI—*Perforation Death Autopsy*

Female, colored, cook, aged forty-four years, hospital No 778, admitted June 7, 1910, on the ninth day of a violent typhoid, positive Widal, and 4000 leucocytes with moderate distention of the abdomen. Soon after her admission she had an 11-ounce hemorrhage, with a 12-ounce hemorrhage on the following day. On the eleventh day she complained of abdominal pain, the severity not stated. At this time there was slight tenderness, distention, and some rigidity of the abdomen. Her leucocytes were 6500 and the differential count showed 70 per cent polymorphonuclears, 20 per cent small lymphocytes, 1 per cent large lymphocytes, 3 per cent mononuclears, and 6 per cent transitionals. On the twelfth day the pain, tenderness and rigidity were marked, patient lay with legs and thighs flexed, expression was anxious, she had vomited once, and had a rapid thready pulse. On the thirteenth day she was seen by a surgeon who thought she had a perforation, but owing to her almost moribund condition, declined to operate. Death occurred shortly afterwards. Autopsy. Typhoid ulceration of the intestines, pin-head perforation in the ileum near the ileocaecal valve, with another perforation one cm in diameter in the ileum 60 cm above the ileocaecal valve, acute purulent peritonitis, pyæmic abscess of the kidneys, and œdema of the lungs.

### CASE CXVII—*Perforation Operation Death Autopsy*

Male, white, tailor, aged twenty-two years, hospital No 1032, admitted June 29, 1910, on the seventeenth day of a severe infection, with a negative Widal and 7600 leucocytes. This patient had been very ill from the time of his admission and was very toxic. On the twenty-third day developed marked tenderness and rigidity over McBurny's point with marked acceleration of pulse and respirations, pulse 84 to 120 and respirations 32 to 44, without any marked change in the temperature. Leucocyte count soon

after the onset of pain was 8200 with 83 per cent polymorphonuclears, two hours later there were 9200 leucocytes, and 5 hours before operation, 9200. Operation was done under ether anaesthesia, 28 hours after the onset of pain. A small perforation found in the ileum 3 inches from the ileocaecal valve. Perforation was closed and the abdomen drained with gauze. The patient did well for 5 days, when he became very sick, profoundly toxic, and died on the seventh day after operation. It was thought the cause of death was toxæmia from his typhoid. Autopsy showed extensive ulceration of the ileum, adhesive peritonitis, plastic pleurisy, splenic infarct, congestion of the lungs with a secondary perforation of the ileum, 5 mm in diameter and 15 cm above the ileocaecal valve.

CASE CXVIII—*Perforation Operation Death*

Male, white, driver, aged twenty-four years, hospital No 1591, admitted August 16, 1910, on the eleventh day of a severe infection, with a positive Widal and 4800 leucocytes. The patient had been very sick but it looked as if he were nearing convalescence. On the twenty-third day he was seized with sudden severe abdominal pain after taking a glass of milk. This was accompanied by a chill, his pulse was elevated from 80 to 120, respirations from 24 to 36, temperature increased 3.2 degrees, his abdomen became generally rigid and tender, and he was operated upon 6 hours after the onset of pain under ethyl-chloride-ether anaesthesia, through a right rectus incision. A plastic peritonitis was found with purulent exudate. There was a perforation in the ileum near the caecum the size of a pea. The abdomen was irrigated and drained with gauze, he did well for 5 days, when he developed lobar pneumonia of the right base, and died on the seventh day after operation without any unsatisfactory abdominal symptoms. No autopsy.

CASE CXIX—*Perforation Operation Death*

Male, white, clerk, aged seventeen years, hospital No 1942, admitted September 20, 1910, on the twenty-first day of a severe illness, with a positive Widal and 9400 leucocytes. From the time of his admission he had a distended abdomen with diarrhoea. On the thirty-fifth day he suddenly developed severe abdominal pain with marked tenderness and rigidity of the abdomen in the right lower quadrant, vomited, became cyanotic, his pulse was very rapid and almost imperceptible, his respirations were hurried, and his temperature dropped 3 degrees. His leucocytes just before operation were 7450. Operation was done 2 hours after the onset of pain under ether anaesthesia through a right rectus incision. A small perforation was found in the ileum 8 cm above

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the ileocæcal valve The ulcer was inverted, the abdomen was drained with gauze, and the patient never fully reacted from the shock attending the operation Death occurred 22 hours after operation No autopsy

### CASE CXX—*Perforation Operation Death*

Male, white, laborer, aged twenty-five years, hospital No 2389, admitted October 28, 1910, on the seventeenth day of a moderately severe infection, with a positive Widal and 2900 leucocytes This patient had almost continuous but not severe pain beginning on the eighteenth day It was never severe but persistent and just enough to make the patient uncomfortable most of the time On the twenty-fourth day it became a little more severe and he developed a little tenderness He soon developed a little rigidity but there was never any severe outburst of pain and there was no change in his temperature, pulse, or respirations at any time, but owing to the persistent pain, tenderness, and rigidity it was thought that he probably had a perforation Leucocytes just before operation were 3250 Operation was done 12 hours after his pain became worse under ether anæsthesia through a right rectus incision There was considerable soiling of the peritoneal cavity, plastic peritonitis, and there was a perforation the size of a pea in the last portion of the ileum It was closed, the abdomen was irrigated with salt solution and drained with gauze Death occurred on the fifth day after operation, probably from peritonitis Autopsy was not done

### CASE CXXI—*Perforation Operation Death*

Male, white, laborer, aged thirty-four years, hospital No 4446, admitted April 12, 1911, on the sixteenth day of a moderate infection This patient had been feeling ill with headache and general malaise for two weeks and stated that he had had abdominal pain for the last 8 days previous to admission He was referred to the hospital and diagnosed as acute appendicitis There was no history of sudden acute abdominal pain elicited On admission his abdomen was distended, generally rigid and tender, he had a temperature of 101°, and presented the picture of general peritonitis It was thought that he probably had typhoid fever with perforation Operation, ethyl-chloride-ether anæsthesia, soon after admission, the abdomen was opened through the right rectus, diffuse peritonitis was found with effusion of the intestinal contents and adhesions about the last portion of the ileum and cæcum A perforation was found in the ileum, near the cæcum, 2 mm in diameter It was inverted with a purse-string suture, the abdomen was irrigated, and rubber-covered gauze



drainage instituted Death on fourth day after operation, probably resulting from peritonitis No autopsy

CASE CXXII—*Perforation Operation Death*

Male, white, barber, aged twenty-two years, hospital No 750, admitted May 30, 1911, on the eighteenth day of a severe typhoid, negative Widal, and 5400 leucocytes His abdomen was distended and he had diarrhoea with considerable toxæmia from the time of his admission This patient on the twenty-second day "developed symptoms of peritonitis" Operation was done soon after under ethyl-chloride-ether anæsthesia A small perforation was found which was closed, the abdomen was irrigated and drained On the second day after operation developed pneumonia and died on the fourth day, probably as a result of the pneumonia No autopsy

CASE CXXIII—*Perforation Operation Death*

Male, white, hospital No 2102, admitted September 20, 1911, on the eighteenth day of a moderate infection, with a positive Widal and 6500 leucocytes On the twenty-third day (P.M.) patient had pain, but not severe, in the right iliac fossa with tenderness and slight rigidity, but the abdomen was not distended His general condition was good, there was no pulse change, leucocytes 15,600 During the night he had two attacks of sharp pain of only a few minutes duration, next morning he had dull pain, a little tenderness and slight rigidity His leucocytes were again 15,600 He was seen by a surgeon and operation was considered but deferred because it was thought that he probably had not a perforation He slept soundly during that night, but vomited twice early next morning, had hiccoughs, his abdomen had become more rigid and tender, it was now distended, his pulse rate had increased and his temperature was slightly fluctuating His leucocyte count at that time was 2200 Thirty hours after onset of pain operation was done under ether anæsthesia, right rectus incision The peritoneal cavity was filled with fluid and intestinal contents, there was general peritonitis with a small perforation in the ileum a few inches from the cæcum The abdomen was irrigated, the wound closed, death 6 hours later No autopsy

CASE CXXIV—*Perforation Operation Death*

Male, white, ship rigger, aged twenty-two years, hospital No 1091, admitted July 4, 1912, on the fifth day of a severe infection, with a positive Widal, positive blood culture for typhoid bacilli, 7300 leucocytes, a distended abdomen and slight diarrhoea This patient had gone through a short but severe typhoid with a persistently high temperature On the nineteenth day, his temperature having been normal for 4 days, he had a severe chill and

developed severe abdominal pain with localized tenderness and rigidity in the right lower quadrant. He had marked acceleration at this time of pulse and respiratory rate, his leucocytes soon after the chill were 5200 with 68 per cent polymorphonuclears. He was watched by the attending physician for 2 hours, during which time his symptoms abated, his condition seemed much improved and operation was deferred. At the end of 12 hours from the onset of his pain, he became worse, with increased tenderness and rigidity, leucocytes 12,000 and 88 per cent polymorphonuclears. Operation under ethyl chloride anæsthesia through a right rectus incision. There was much free fluid in the abdomen and a pin-head perforation was found in the ileum half an inch from its juncture with the cæcum. The point of perforation seemed to have become adherent, it was closed, the abdomen was irrigated, and gauze drainage instituted. Patient did well for 4 days, except for a profuse intestinal hemorrhage shortly after operation, but died on the sixth day, probably from pneumonia. This patient had had typhoid 5 years before. No autopsy.

CASE CXXV—*Perforation Operation Death Autopsy*

Female, white, housework, aged twenty-one years, hospital No 1747, admitted September 3, 1912, on the twenty-first day of a severe infection, with a positive Widal and 5900 leucocytes. The abdomen was distended, she had diarrhœa, with two profuse hemorrhages after admission. On the thirtieth day she developed lobar pneumonia but before this she had been profoundly toxic. On the thirty-seventh day she had a severe chill, circulatory collapse, and cyanosis. Her temperature dropped 3 degrees with a subsequent 4-degree elevation. On the following morning marked abdominal tenderness was noted with increased distention and general rigidity. Perforation was diagnosed. Her leucocytes at this time were 17,600. The abdomen was opened through a median suprapubic incision, there was much purulent fluid with lymph over the intestines and a small "punched-out" perforation in the ileum an inch from the ileocæcal valve. The loop bearing the perforation was brought into the wound, sutured to the skin, and the perforation enlarged. The wound was drained and Murphy treatment instituted. The patient died a few hours later. Autopsy revealed extensive ulceration of the ileum with a general purulent peritonitis and another small perforation in the ileum, 18 inches above the ileocæcal valve.

CASE CXXVI—*Perforation Operation Death*

Female, white, cook, aged twenty-nine years, hospital No 1346, admitted July 21, 1913, on the fourteenth day of a very severe infection, with a positive Widal and 8100 leucocytes. This

patient was profoundly toxic and had marked abdominal distention with diarrhoea, from the time of admission. At the time of her admission it was noted that she had marked pulmonary involvement, with "signs suggesting a typical pneumonia with decided meningeal symptoms." On the thirty-eighth day she had severe sudden abdominal pain, marked tenderness and rigidity of the right lower quadrant, anxious expression, severe shock with cyanosis, obliterated liver dulness, increased pulse rate from 112 to 150, and very weak increased respiratory rate. Operation soon after under ether anæsthesia, right rectus incision. On opening the peritoneum there was found marked effusion of the intestinal contents with a perforation, the size of a dime, in the ileum, location not stated. This portion of the intestine was brought into the wound and anchored with a suture and gauze. The perforation was not closed and the pelvis was drained through a suprapubic stab wound. Died 24 hours later. No autopsy.

CASE CXXVII—*Perforation Operation Death*

Male, white, manufacturer, aged twenty-seven years, hospital No 1638, admitted August 11, 1913, on the twelfth day of a severe typhoid, with a positive Widal and 10,100 leucocytes. The abdomen was distended on admission. This patient on the seventeenth day complained of rather severe pain with tenderness in the right upper quadrant of the abdomen, he vomited once or twice, and there was rigidity of the right upper rectus. The attending physician thought that he had a cholecystitis. This condition persisted, his pain and tenderness becoming a little more generalized, with leucocytes 13,400 on the day of onset. His pulse increased from 88 to 120, respirations from 24 to 36, and his temperature was slightly remitting in character. Forty-eight hours after the onset of pain, tenderness and rigidity became much more marked, his liver dulness was obliterated with evidence of fluid in the peritoneal cavity. His leucocytes the day before were 12,700 and just before operation, 14,700. Operation under ether anæsthesia 48 hours after onset of pain, right rectus incision. On opening the peritoneum diffuse purulent peritonitis was found with effusion of intestinal contents and a perforation 2 cm in diameter in the ileum, 12 inches above the ileocæcal valve. Inversion of the ulcer was attempted but the sutures would not hold and the loop of intestine bearing the perforation was brought into the wound, surrounded with gauze, and the abdomen drained after irrigation, with a rubber-covered gauze drain, with a small suprapubic stab drain in the pelvis. Death occurred 6 hours later. No autopsy.

CASE CXXVIII—*Perforation Operation Death*

Male, white, laborer, aged thirty-one years, hospital No 1848,

admitted August 31, 1913, on the eighth day of disease, with a severe infection, a negative Widal and 5400 leucocytes. On the thirteenth day he was seized with sudden severe abdominal pain with tenderness and rigidity in the right lower quadrant "his temperature dropped, and pulse and respirations were much increased." It was thought that he had a perforation and operation advised, which was done under ether anæsthesia. A pin-head perforation was found in the ileum, location not stated, perforation was closed, and abdomen drained with gauze. Patient reacted poorly from the shock of the operation and died 17 hours later. No autopsy.

#### CASE CXXIX — *Perforation Death Autopsy*

Male, white, student, aged fourteen years, hospital No 2814, admitted November 13, 1913, on the sixth day of a moderate infection, with a positive Widal and 4200 leucocytes. This patient was not very ill but his course was protracted, abdomen distended a great deal of the time, had diarrhœa with several slight hemorrhages during the fifth week. On the fortieth day he was in fairly good condition when he developed sudden severe, cramp-like pain in the epigastrium, which was later referred to the right iliac fossa. He had several recurring attacks without change in pulse. His temperature dropped, however, from 102° to 98°, he developed tenderness over both lower quadrants, but more marked over the right. He was seen by a surgeon 8 hours later, perforation was diagnosed, but operation was declined on account of his extreme condition. Death occurred the next day. Partial autopsy revealed general peritonitis with extensive ulceration of the ileum and a pin-head perforation 3 inches above the ileocæcal valve. Many other ulcers had extended to the peritoneal covering.

#### CASE CXXX — *Perforation Operation Death Autopsy*

Male, white, salesman, aged forty years, hospital No 2021, admitted July 7, 1914, on the tenth day of a very severe infection, with a positive Widal and 5600 leucocytes. From the time of his admission he had abdominal distention and diarrhœa. On the thirteenth and fourteenth days he had 4 profuse intestinal hemorrhages. On the fourteenth day he was seized with severe, cramp-like pain in the umbilical region and over the lower abdomen. His pulse and respirations were markedly accelerated. With this he developed great rigidity and tenderness of the lower abdomen which soon became generalized, leucocytes were 9200, peristalsis was diminished, there was obliteration of liver dulness, and he was considerably shocked. Operation was done two hours after onset of pain, the abdomen being opened under local anæsthesia and concluded under ethyl chloride anæsthesia. Two perforations

were found in the ileum, one, 1 cm in diameter, 6 inches above the ileocæcal valve, and the other, pin-head in size, 2 feet above the ileocæcal valve. There was much leakage of intestinal contents, the perforations were closed, the abdomen was irrigated with salt solution, and rubber-covered gauze drainage instituted. He did well for 36 hours, then began to fail, and died 50 hours after operation. Autopsy revealed diffuse peritonitis, no other perforation, congestion of the lungs and liver, acute splenic tumor, and acute parenchymatous nephritis.

CASE CXXXI—*Perforation Operation Death Autopsy*

Male, white, iron worker, aged twenty-four years, hospital No 2153, admitted July 18, 1914, on the seventh day of a severe infection, with a positive Widal and 4800 leucocytes. The patient had been quite sick and very toxic from the time of admission. On the seventeenth day his abdomen became more distended and a little later he developed sudden severe, cramp-like abdominal pain with increasing distention, with generalized rigidity and tenderness, both being more marked in the lower right quadrant. There was no marked change in pulse, temperature, or respirations. His leucocytes on the day before operation were 4000 and the differential count showed 65 per cent polymorphonuclears, 10 per cent mononuclears, 23 per cent small mononuclears, and 2 per cent eosinophiles. Just before operation there were 4200 leucocytes with 75 per cent polymorphonuclears. Soon after this he was operated upon under ethyl-chloride-ether anæsthesia, right rectus incision. No perforation was found, there were many deep ulcers in the ileum and one might be described as being in the pre-perforative stage and was inverted with a purse-string suture, peritonitis was present but its extent was not stated. The abdomen was then drained with a rubber-covered gauze drain. Patient did not do very well after the operation, developed a right basal pneumonia and died on the fourth day after operation. A partial autopsy showed that the pre-perforative ulcer had sloughed and perforated. There was also another perforation near this, pin-head in size, with a diffuse peritonitis.

CASE CXXXII—*Perforation Operation Intestinal obstruction Secondary operation Death Autopsy*

Male, white, farmer, aged twenty-one years, hospital No 2255, admitted July 25, 1914, on the twenty-sixth day of a severe infection, a positive Widal and 4200 leucocytes. This patient had a primary attack of 36 febrile days and was then convalescent until the forty-seventh day, when his temperature rose to 103°, remaining up for 10 days and reaching normal again on the fifty-seventh day. During this time he had considerable abdominal

distention His temperature remained normal again until the seventieth day, apparently convalescent again, in good physical condition, and fairly well nourished During the last 6 days of this afebrile period, he had slight diarrhoea, 4 or 5 movements daily, he had been out in a chair for 3 successive days, and was on extra diet, when he developed slight abdominal pain which he did not report for 6 hours At the end of that time it suddenly became very severe, the abdomen tender and rigid over both lower quadrants, but more marked over the right, peristalsis was practically absent, he had a severe chill with a 5-degree elevation of temperature, liver dulness was obliterated, expression anxious, his hands were cyanosed, and he looked as if he were suffering from shock, but the pulse and respiratory rate had not changed Two hours after onset of severe pain he was operated upon under ether anæsthesia and a perforation was found in the ileum 2 inches above the ileocæcal valve The abdomen was irrigated and rubber-covered gauze drains used for drainage and the section of the intestine bearing the perforation was drawn into the wound, the perforation enlarged, and a fistula established after the method employed by Hays He did well for 3 days when he developed intestinal obstruction, for which he was operated upon the second time It was found that a band across the last loop of the ileum was the cause of the obstruction, which was relieved He died 36 hours later from peritonitis Partial autopsy was done and revealed diffuse peritonitis with another perforation in the cæcum

#### CASE CXXXIII—*Perforation Operation Recovery*

Male, white, factory worker, aged twenty-one years, hospital No 2647, admitted August 31, 1914, on the twenty-first day of a severe typhoid, with a negative Widal and 7000 leucocytes He had rather marked abdominal distention and slight diarrhoea from the time of his admission On the twenty-eighth day he was suddenly seized with recurring cramp-like pain, he vomited once, his abdomen became very tender and rigid in the right iliac fossa, there was no change in his pulse or respiratory rate, or his temperature, there was marked tenderness on rectal examination, and just before operation his leucocytes were 12,000 with a differential count of 87 per cent polymorphonuclears, 3 per cent large mononuclears, 10 per cent mononuclears Operation was done 7 hours after onset of pain, which for the first two hours had been slight, then became severe, cramp-like and recurring A pin-head perforation was found in the ileum 6 inches from the ileocæcal valve It was closed, and the abdominal wound closed without drainage He did well for 6 days, when he had frequent vomiting with increasing abdominal distention and considerable pain It was

thought that he had an obstruction Under ethyl chloride anæsthesia the wound was opened, the presenting loop of small intestine was walled off with gauze, and it was then opened with a cautery establishing a fistula Much gas and fecal matter escaped, relieving the patient He continued to do well and the wound slowly healed, although it was probably in the lower jejunum, and he was discharged cured on the one hundred and twenty-eighth day after operation

CASE CXXXIV—*Perforation Operation Death*

Male, white, laborer, aged thirty-eight years, hospital No 2827, admitted September 19, 1914, on the twenty-first day of an ambulatory typhoid No record of Widal or leucocytes This patient had been sick for about 3 weeks with the usual symptoms of a mild typhoid During most of this time he worked Two days before admission to the hospital, while he was sitting in a chair, he was seized with severe abdominal pain which he says persisted On admission his temperature was 103° with marked generalized tenderness and rigidity, liver dulness was obliterated, and the patient was in an almost moribund condition Operation was done under ether anæsthesia and a large perforation found in the ileum 3 inches above the ileocæcal valve with diffuse peritonitis Perforation was closed, the abdomen was irrigated and drained with a rubber covered gauze drain He died about 15 minutes after the operation

CASE CXXXV—*Perforation Operation Recovery*

Male, white, salesman, aged thirty years, hospital No 2964, admitted October 2, 1914, on the tenth day of a moderate infection, with a positive Widal and 7000 leucocytes His abdomen was distended most of the time after admission On the twelfth day he developed sudden cramp-like pain recurring at short intervals, with tenderness and rigidity over both lower quadrants, more marked on the right side, and without change in pulse or respirations There was a 2-degree drop in temperature at the onset of pain with a 4-degree elevation shortly afterwards His leucocytes were 7400 and there was marked rectal tenderness with dulness in the right flank In about 10 hours from onset of first pain he was operated upon, ether anæsthesia A perforation was found in the ileum 3 inches above the ileocæcal valve, size not stated The abdomen was drained with rubber covered gauze drains Patient stood the operation well, running a moderate febrile course without complications for 23 days after operation At this time his wound had practically healed and he was discharged from the hospital cured on the thirty-ninth day after operation

## TYPHOID PERFORATION

### CASE CXXXVI—*Perforation Operation Recovery*

Male, white, factory worker, aged seventeen years, hospital No 3239, admitted October 25, 1914, on the twelfth day of a severe infection, positive Widal and 5000 leucocytes. On the nineteenth day he had abdominal pain with a chill, 3-degree elevation of temperature, 20 per cent increase in pulse rate, with abdominal distention, leucocyte count of 9200 at the onset of pain with a subsequent count of 9600. His pain was not very severe but there was marked tenderness on palpation, peristalsis was much diminished, liver dulness was diminished, but its obliteration was doubtful. Operation about 6 hours after onset of pain under ethyl-chloride-ether anæsthesia through a right rectus incision. A small perforation was found in the ileum 3 inches above the ileocæcal valve. The abdomen was drained with a rubber tube which extended into the pelvis. The patient continued an uncomplicated febrile course for 14 days after operation, there was considerable drainage from the wound for the first few days and he was discharged cured on the forty-second day after operation.

### CASE CXXXVII—*Perforation Operation Recovery*

Male, white, laborer, aged twenty-three years, hospital No 3269, admitted October 27, 1914, on the sixth day of a moderate infection, with a positive Widal and 3800 leucocytes. On the tenth day after a bowel movement the patient complained of rather severe abdominal pain and tenderness. Soon after the onset of pain he vomited, developing rigidity of the recti which was more marked over the right upper rectus than over the right iliac fossa. He also had decided tenderness and resistance in the right flank and loin. He lay with both knees drawn up, peristalsis was diminished, and there was little if any change in the liver dulness. There was no decided change in the pulse (100) or respiratory rate and no temperature change. His leucocytes were 5000. Operation was done as soon as he could be prepared, under ethyl-chloride-ether anæsthesia, through a right rectus incision. A pin-head perforation was found in the ileum 12 inches above the ileocæcal valve. Perforation was closed and drainage was established through a rubber tube which extended into the pelvis. He continued a mild febrile course for 14 days after operation, he was then convalescent for 10 days, when he had a mild relapse from the twenty-fourth to the forty-first days after operation, after which he made an uneventful recovery. Discharged cured on the sixtieth day after operation.

### CASE CXXXVIII—*Perforation Operation Death Autopsy*

Male, white, laborer, aged nineteen years, hospital No



3865, admitted December 22, 1914, on the fifth day of a severe typhoid, a positive Widal and leucocytes. This patient was very sick and profoundly toxic from the day of his admission, his abdomen was distended, he had diarrhoea and 8 hemorrhages from the tenth to the thirteenth days, totalling 56 ounces. On the thirteenth day he developed sudden severe abdominal pain lasting for about half an hour, with subsequent generalized rigidity and tenderness with marked acceleration of the pulse and respirations and a 4-degree drop in temperature. On the day before perforation his leucocytes were 7100, just after the onset of pain they were 11,000. Operation was done soon after the onset of pain, the abdomen being opened under local anæsthesia and the operation concluded under ethyl chloride. There was much leakage of intestinal contents and a perforation was found in the ileum 12 inches from the ileocæcal valve. It was closed and a rubber drainage tube inserted into the pelvis. His condition became very critical on the table and he was given salt solution and adrenalin intravenously. He died 10 hours later. A partial autopsy revealed general peritonitis without any other perforation.

CASE CXXXIX—*Perforation Operation Recovery*

Male, white, milkman, aged twenty years, hospital No 38, admitted January 14, 1915, on the ninth day of a moderate infection, with a very suggestive Widal and 8800 leucocytes. On the eleventh day he developed sudden severe paroxysmal pain in the abdomen, lasting three to five minutes and recurring at ten- to fifteen-minute intervals, without rigidity and but slight tenderness between the first two paroxysms, both pain and tenderness becoming more marked after this. The pain was referred to the penis and the right iliac fossa, tenderness in the right iliac fossa was decidedly increased on turning the patient to the left side, liver dulness was diminished and there was decided tenderness on rectal examination. There was no appreciable change in pulse or respirations, and no change in temperature. The abdomen was slightly distended, peristalsis was active at first but was soon very much diminished. During one of the attacks of pain he had a normal bowel movement which increased the pain considerably, his expression soon became anxious, which was not noted at the onset of pain, his respiratory movements became thoracic and his leucocytes just before operation were 11,100. Operation was done 3 hours after the onset of pain under ethyl-chloride-ether anæsthesia, through a right rectus incision. On opening the peritoneum considerable fluid was found with a small amount of fecal matter. A pin-head perforation was found in the ileum 12 inches above the ileocæcal valve. It was closed

and the abdomen was drained through a rubber tube which extended into the pelvis. His condition was good at the conclusion of the operation, pulse 120 on returning to the ward and was 88 just before the operation. The febrile course of the disease seemed uninterrupted by the operation, his temperature became normal on the tenth day after operation, remaining normal for 7 days, then he had a relapse running a moderate fever for 2 weeks. After this he made an uneventful recovery and was discharged cured on the forty-fifth day after operation.

*Symptoms*—A rehearsal of the symptoms of typhoid perforation would seem unnecessary and of little use because I believe our errors result not from any lack of knowledge regarding the symptoms but rather from a hesitancy to comprehend the importance of promptly acting when these symptoms present themselves. The two most valuable symptoms are pain and rigidity, and on these two symptoms we must rely nearly altogether. Of course if the pain comes on suddenly and the rigidity is marked, a perforation must be suspected and exploration made. From a study of our cases I think the mistake of attributing the pain and rigidity of a thoracic lesion to a perforated ulcer is unlikely, but of course a careful examination of the chest should always be made. Sudden severe pain and board-like rigidity indicate a perforation of some size with considerable leakage and the diagnosis is comparatively easy. The less sudden and less severe the pain and rigidity, the more difficult the diagnosis becomes. Digital examination per rectum should always be made and often will reveal acute tenderness, which is of great significance. Difficult, painful or frequent urination often occurs. Changes in pulse rate and temperature are of no great diagnostic value and the sudden fall of temperature with an increased pulse rate often means hemorrhage. Our case records do not show the extensive use we have made of blood counts in these cases but we are convinced that the absence of a leucocytosis is of no diagnostic value. As a rule, it takes from eight to twelve hours for the average case of perforation to develop a leucocytosis. The presence of a leucocytosis, of course, is of diagnostic value. We have learned to put little faith also in the presence or absence of liver dulness, but if the liver dulness is absent and the abdomen is flat, perforation probably has taken place.

*Treatment*—When the symptoms are sufficient to make the attending physician and surgeon believe that a perforation has probably occurred, there should be no delay in operating. I am sure that my own mistakes have been in this connection and I believe the cases here reported clearly show that delay, after the onset of pain and rigidity, is

the cause of the high mortality following operations for perforation in typhoid fever. It has not been our experience that a quick exploration does much harm, even where no perforation is present, in the large majority of cases a definite cause for the symptoms is found and justifies the exploration.

At the present time when there is so much controversy regarding the type of anæsthetic, one hesitates to attempt to lay down any rule. Infiltration anæsthesia preceded by morphia and atropine certainly offers the safest means of confirming the diagnosis and in the majority of instances is quite sufficient for the entire operation. In several of my own cases the operation throughout has been conducted under chloride of ethyl anæsthesia. I can readily understand why some would prefer gas alone, or gas and oxygen. The frequent development of lung complications after these operations convinces me that ether anæsthesia increases the hazard. It seems needless to say that the duration of anæsthesia should be as brief as possible and that the operation itself should be conducted with expedition, 10 or 15 minutes will suffice in the majority of instances. Many of these cases are lost because the patients are completely anæsthetized, often with ether, before the surgeon is ready to begin the operation. The safest rule is to open the abdomen under infiltration anæsthesia and administer a general anæsthetic only if it is necessary, and then for as brief a time as possible.

The question of how the perforation itself should be treated is still a matter of controversy. In the cases here reported, a closure of the perforation with drainage of the abdomen has been the rule, but in a number of cases the perforated bowel has been sutured in the wound and allowed to drain. Hays of Pittsburgh (*Penna Medical Journal*, 1908) advocates very strongly the performance of enterostomy, and his personal statistics bear out the value of this method. Hutchinson of the Pennsylvania Hospital also advocates this method.

Hays has operated upon 38 cases with a recovery rate of 36 per cent, which constitutes the best report with which I am acquainted.

The question of irrigation and the type of drainage must be left largely to the operating surgeon to decide. Personally I do not like irrigation and always employ a rubber covered drain. Continuous enteroclysis is the most important part of the after-treatment. The Fowler position, although of great help in many cases of perforative peritonitis, is not always advisable in typhoid fever, as the patient is often too weak to stand it. Hays employs a glass drainage tube, but I have always felt that the rigid unyielding tube is apt to give rise to adhesions and subsequent obstruction.

## TYPHOID PERFORATION

*Post-operative Course*—Most of the deaths that occur within a few hours may be attributed to shock and toxæmia. Those occurring late result from lung complications and from peritonitis. One of our series died two weeks after operation from double parotid bubo. Secondary perforations are frequent and are usually fatal, because they are not recognized. Three of our cases were operated upon a second time, one for perforation and two for obstruction. There were 26 autopsies made in our fatal cases and in 14 of them secondary perforations had occurred. In 2 cases there was a sloughing of a repaired ulcer and in 2 other cases there was sloughing and also a secondary perforation. One of our successful cases operated upon by Harte had 2 perforations in the ileum, one in the appendix, and 3 distinct relapses after operation. This case illustrates the resistance sometimes shown in bad cases of typhoid. In 2 cases 5 distinct perforations were found at operation. In one case the perforation was repaired and the abdomen closed without drainage, a fecal fistula developed and later a pelvic abscess, which was drained through the rectum, and the patient recovered.

# FREQUENCY OF CHEST COMPLICATIONS AMONG THE WOUNDED

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IN view of the frequent occurrence of pathological lung conditions revealed at routine autopsies in this Ambulance (The American Hospital of Paris), it was decided to review the total number of autopsies on record with the idea of ascertaining the frequency of pathological conditions of the lungs and pleura among the fatal cases

Fifty-one autopsy reports have been examined, comprising all in which an examination of the chest was made. The following is a list of the number of times in which a pathological condition was recorded

Lobar pneumonia	6
Bronchopneumonia	15
Plastic fibrinous pleurisy	27
Pleurisy with effusion	8
Empyema	2
Passive congestion (extensive)	2
Hæmothorax	4
Pneumothorax	1
Negative findings	9

Many of the cases presented several conditions, for instance, five out of six of the lobar pneumonias showed adherent pleura, while nine out of the fifteen bronchopneumonias showed a similar condition. The total number of lesions is therefore in excess of the number of cases autopsied.

An attempt has been made to classify the injuries, taking those which seemed most directly responsible for the death of the patient. The following is a list of the occurrence of such injuries

	Number of cases	Lungs negative
Penetrating wounds of chest	5	
Penetrating wounds of abdomen	4	1
Transverse lesions of cord	4	
Penetrating wounds of brain	10	3
Wounds of thigh	17	1
Wounds of leg and other extremities	6	2
Multiple wounds—too numerous to classify	4	2

## CHEST COMPLICATIONS AFTER WOUND

Combining the list of injuries with the list of lung findings, we find that 43 showed definite microscopical pathology. In all of the 5 penetrating chest wounds, in 4 of the 5 penetrating wounds of abdomen, in 3 of the 4 cord injuries, in 6 of the 10 brain injuries, in 16 of the 17 wounds of the thigh, in 6 of the 8 wounds of other extremities, and in 4 of the 6 cases of multiple wounds pathological conditions of the lungs or pleura were present.

The distribution of these lesions may also be seen in the following chart.

Diagnosis	Lobar pneumonia	Broncho-pneumonia	Plastic fibrinous pleurisy	Pleurisy with effusion	Empyema	Hæmothorax	Congestion	Pneumothorax	Negative
Chest (5)		1	3	2		3		1	
Abdomen (4)	1	1	2			1			1
Cord (4)	1	2	2	1	1				
Brain (10)	2	1	4	2					3
Thigh (17)	1	6	9	3			2		1
Other extremities (6)	1	2	5		1				2
Multiple (4)		2	2						2

Further analysis of the 9 negative cases which occurred (1 in a penetrating wound of abdomen, 3 in penetrating wounds of brain, 1 in a wound of thigh, 2 in wounds of other extremities and 2 in cases with multiple wounds) shows that 4 died within five days of injury, a time too short for chronic changes of the lungs to have taken place.

The cases in which pathological lung conditions are certainly to be expected are, of course, those in which there is a penetrating wound of the chest and probably also the high transverse lesions of the cord—which together comprise 9 of the 43 cases showing pathological conditions. This leaves a total of 31 cases out of 51 autopsies in which the lung condition seemed to bear no direct relation to the wound. Some of these, especially a few of the acute bronchopneumonias, are undoubtedly to be explained as part of a general pyæmia or septicæmia. On the other hand, there is left a large proportion of cases in which it is difficult to see any direct relation between the wound and the condition in the chest. The high occurrence of lung conditions in wounds of the thigh (16 out of 17, 94 per cent), as in penetrating wounds of the abdomen (4 out of 5) and in transverse lesions of the cord (4 out of 4), suggests that the chronic degenerative changes manifested in the great number of adherent pleuræ may possibly be connected with the matter of posture as well as the general intoxication from the wound itself.

Presumably the acute lung conditions were more or less dependent upon the chronic changes in the pleura

It is worth noting that this high incidence of pathological lung conditions has occurred in a class of patients which should be fairly free from lung affections, all are men between the ages of twenty and forty, who are supposed to have passed a more or less rigid medical examination and who have been living an out-door life for several months

In conclusion it may be stated that 90 per cent (46 of 51) of the wounded dying five days or more after injury have shown at autopsy some gross pathological condition of the lungs or pleura sufficiently marked to be more or less active in preventing recovery from the wound. In more than half (27 out of 51) of these this change was of a chronic degenerative character, unexpected in civil practice in patients of this age and state of health. By far the greatest number of cases was in the type of wound enforcing a dependent position in bed

# THE TRANSVERSE ABDOMINAL INCISION

BY WILLY MEYER, M D

OF NEW YORK

ATTENDING SURGEON TO THE GERMAN AND POST-GRADUATE HOSPITALS

IN the course of the last months I have carried out in a number of cases the transverse abdominal incision, as originally recommended by Sprengel of Braunschweig,<sup>1</sup> and later worked out by Perthes, of Tübingen<sup>2</sup>

I came to employ it as a result of the experience gained in two cases of resection of the cardia in which access to the vault of the diaphragm had to be obtained in the presence of a gastric fistula. The oblique cut gave a better access to major and lesser curvature towards the cardia than any longitudinal, even one through the outer fibres of the left rectus, could have offered, although the latter muscle could not be divided in order to preserve the gastric fistula. I then decided to try the transverse incision for stomach operations, as had been repeatedly urged by other surgeons before<sup>3</sup>

In one case I first tried the approach through a left oblique entrance, which, however, had to be transformed into an acute angle with rounded tip by unforeseen local conditions within the abdomen. Fig 1 shows the peculiar incision, which was done for resection of the greater portion of the stomach for carcinoma. Firm and broad adhesions to the lower surface of the liver and gall-bladder, evidently due to an old ulceration, forced me to continue the first left oblique cut through the right rectus and transversalis muscle and part of the obliques. When completed, the incision, therefore, ran parallel to the costal arch on either side. The flap could be nicely turned downward, affording splendid access for thorough work, nor did I have any difficulty in replacing it and closing the abdomen. Final cicatrix is strong, no tendency to hernia<sup>4</sup>

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<sup>1</sup> Verhändl d Deutschen Gesellsch f Chirurgie, 1910, vol 39, II, p 95

<sup>2</sup> Deutsche Zeitschr f Chir, vol 129, page 493, and Centralbl f Chir, 1912, No 37

<sup>3</sup> Moschcowitz, A V Transactions of the New York Surgical Society, April, 1915, page 495

<sup>4</sup> See ANNALS OF SURGERY, Report of Transactions of the New York Surgical Society, May 12, 1915



Figs 2 and 3 show the "typical transverse incision" at the junction of middle and lower third of a line drawn from the xiphoid process to the umbilicus <sup>4</sup>

Fig 4 demonstrates how, by swinging the left extremity of the cut around, the right rectus muscle can be entered and the appendix and gall-bladder reached, if required. The illustration was taken from a patient in whom a duodenal ulcer was suspected, but not found, hence it became necessary to explore the gall-bladder and appendix region. The appendix could be well removed, though it proved to be quite firmly adherent in the small pelvis.

After a skin incision in a transverse, slightly convex-upward direction has been made, the abdomen is entered in the middle line. The left forefinger is introduced through the peritoneal button-hole, and three catgut sutures are placed in a horizontal line about three-fourths of an inch apart with a round curved needle above and below (Fig 5). They grasp rectus fascia and rectus muscle, but not the peritoneum. The finger pressed against the parietal peritoneum from within, guards it from being caught by the needle. Whilst the operator puts in the second suture the assistant ties the first one, and so on. The six sutures on the left having been finished, the surgeon turns his left forefinger for 180 degrees, making a pronounced pronation, and proceeds in the same way to the right of the median line, until the two rows of sutures have been put in on either side (Fig 6).

Now the finger is withdrawn and the original line of skin incision deepened into the abdomen. The belly of the recti muscles having been fixated to the anterior sheath of the rectus fascia, retraction of their fibres is impossible (Fig 7) <sup>5</sup>

Most excellent access is thus gained. By pulling the stomach downward, the lesser curvature particularly becomes well accessible.

By dividing the left or right rectus only, the transverse incision can be nicely used for exploratory palpation and inspection. If more room be needed for a subsequent operation, the inner end of the incision can be swung upward into the median line and run up to the xiphoid (Perthes).

When closing up it is gratifying to note how nicely the different layers of the abdominal wall can be approximated, more so, if the upper part of the body is slightly raised on the operating table. A continuous chromicized catgut suture unites peritoneum plus transverse fascia, the

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<sup>5</sup> Figs 5 and 7 have been reproduced from Perthes' article in the *Centralblatt für Chirurgie*, 1 c, No 5 has been slightly modified.



FIG 1



FIG 2



FIG 3



FIG 4

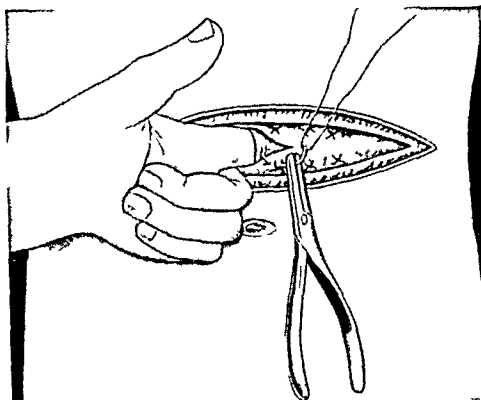


FIG 5



FIG 6

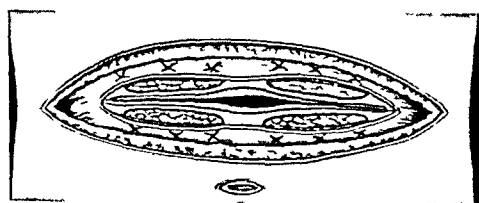


FIG 7



## THE TRANSVERSE ABDOMINAL INCISION

second layer of buried continuous suture approximates the divided muscles, the needle catching the fascia (muscles) *to the outside* of the fixation sutures originally placed, the third layer closes the skin

Retention sutures, which I put in at first, are not required, as the tendency of the abdominal wall, in case of vomiting, coughing or sneezing, is to approximate rather than separate the borders of the wound

I have tried this incision now in eight cases and have been so favorably impressed with it, that I feel it should be more frequently used

# THE CLOSURE OF MUCOCUTANEOUS FECAL FISTULÆ\*

BY EDWIN BEER, M D.

OF NEW YORK CITY

(From the Surgical Service of the Mount Sinai Hospital)

It is a well-recognized fact that, owing to the difficulty of closing a fecal fistula, no simple and classical method of operating on this pathological condition has been developed. Moreover, the methods of procedure described in the various text-books bear evidence to the fact that surgeons frequently have to use all their ingenuity to effect a closure of such a fistula. This paper is written with the object of calling attention to a simple and non-dangerous method<sup>1</sup> of closing a common type of fecal fistulæ, and I believe that if it should prove as satisfactory to others as it has been to me, these lines will go far in the direction of establishing a classical operative technic.

Every surgeon who has dealt, extraperitoneally, with fecal fistulæ of the small and of the large bowel, fecal fistulæ in which the intestinal mucosa and skin are in apposition (and to this type alone my paper refers), must have noticed that though using the identical technic, in one case a permanent closure is effected and in the next case the operation fails. I have seen this again and again. Gradually it dawned upon me that the cases that were immediately successful and those that broke open but subsequently closed, had one point in common, *i e*, the suture line in the gut was at a considerable depth from the skin and more or less covered by the subcutaneous fat drawn over it by the cutaneous suture. The great value of this subcutaneous fat as well as of the wide separation of skin and suture line in the gut, I came to recognize fully. To insure this separation of suture line and skin, and to definitely cover the suture line with healthy subcutaneous fat, the following operation was devised. In closing defects in the rectal suture line after resection, Enderlen applies a similar method with success.

The underlying principle of this operative procedure is to separate the suture line from the skin by a layer of healthy adipose tissue and in this way either obtain a primary closure of the opening in the gut or, in case this fails, to promote a secondary closure by making the resulting sinus an oblique and tortuous one. The operation is extraperi-

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\* Lippen Fistel of the Germans

<sup>1</sup> First described before the N Y Surgical Society, ANN SURG, 1915, lx1, 110

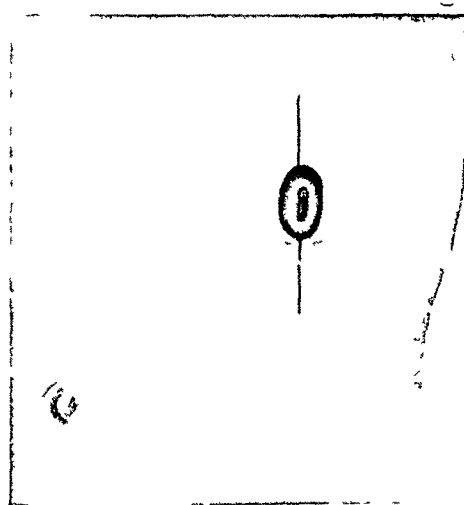


FIG 1 —Circumcision of fistula at mucocutaneous margin, incision through skin and subcutaneous fat above and below fistula

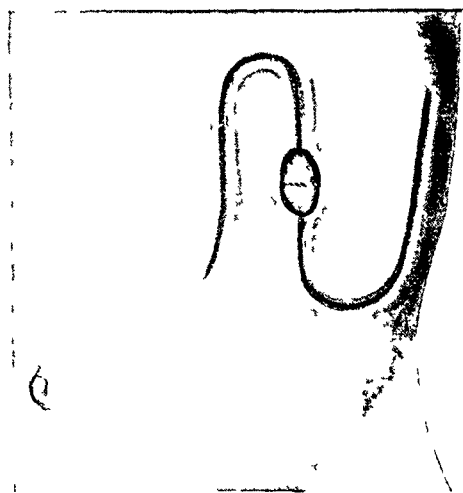


FIG 2 —Transverse suture of stoma in gut, fashioning of two unequal skin fat flaps on either side of closed stoma

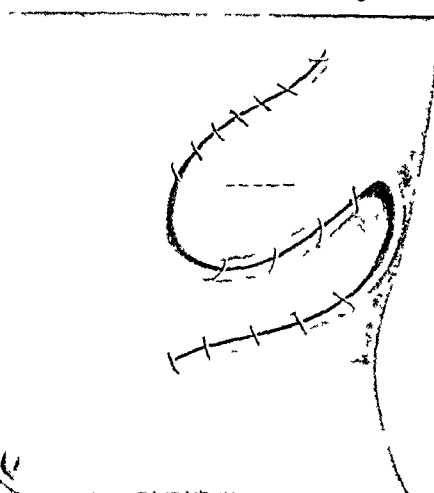


FIG 3 —Shifting of skin-fat flaps so that broader one covers sutured stoma, attachment of these flaps with few skin sutures in new positions



toneal, very simple and can be done readily under local anæsthesia. I have tried it in the three cases here described and found it highly satisfactory.

*Technic*—As the figures clearly show, an incision is made through skin and subcutaneous fat above and below the fecal fistula. Then the fecal fistula is circumcised at the mucocutaneous junction and the adjacent intestinal wall is liberated sufficiently to allow of passing a layer of turning-in sutures<sup>2</sup>. These sutures should run transversely to the long axis of the gut so as to increase its lumen at this point. Having closed the opening with this layer of fine plain catgut sutures, two unequal pedunculated flaps (Fig. 2) are fashioned out of the adjacent skin and subcutaneous tissues and so shifted that the broader flap lies over the suture line in the intestine. The narrower flap (half as wide as the broader flap) is then switched around into the denuded area from which the broader flap has been moved. A few skin sutures hold the flaps in their new positions without tension, and a piece of rubber dam introduced just under the lower flap, where approximation is not feasible, serves as drainage<sup>3</sup>. Some sloughing of the tip or of one edge of one of the flaps has usually taken place. Perhaps a better anatomical knowledge of the blood supply in the superficial tissues will help to avoid this in the future. It is also possible that by using a bridge flap attached at both ends, and sliding it into the denudation caused by excision of skin and subcutaneous tissue on the other side of the fistula, one may prevent such slight necroses, which, though undesirable, have not interfered with the object of the whole procedure.

CASE I—M, sixty years of age. Carcinoma of upper part of descending colon.

October 1, 1913. First stage Mikulicz operation. Large tumor and adjacent gut fastened in wound.

October 6, 1913. Second stage Mikulicz operation. Eventrated gut and tumor cut away almost flush with skin. Subsequently, fecal fistula refused to close despite repeated attempts to destroy "spur". After waiting eleven months to determine whether metastases had developed and as there were no signs of such a complication, I determined to close the artificial anus through which most of the fecal current discharged.

September 2, 1914. Closure of fecal fistula under local anæsthesia. The fistulous opening admitted the index finger readily.

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<sup>2</sup> The peritoneal cavity should not be opened.

<sup>3</sup> After shifting the flaps two denuded areas remain in that condition on either side of the operative field.



It was packed with gauze to prevent soiling and then the gut was separated from the skin by incising the mucocutaneous junction. Two incisions through the skin and subcutaneous fat were made, extending above and below the fistula two to two and one-half inches. The adherent gut was carefully detached for about one-half inch about the fistula, and the opening was closed by a single layer of turning-in fine catgut sutures transversely to the long axis of the bowel. Then the two skin and subcutaneous fat flaps were dissected up, one having its pedicle above and the other below, and these flaps were switched about so that the larger one covered the suture line in the gut. A few interrupted silk sutures held the flaps in place. Small rubber dam drainage was introduced under lower flap, not, however, reaching to the vicinity of the sutured gut, and a firm dressing applied.

After the operation the patient was placed on opium for the greater part of a week and then his bowels were moved. The flaps healed in satisfactorily. There was a small area of superficial necrosis along the edge of one flap. There was slight leakage from the intestine for a short time and then this ceased and the intestine remained closed, all its contents passing by the normal route.

October, 1914 Discharged cured

CASE II—M, twenty-nine years of age. Acute appendicitis, peritonitis. Admitted June 30, 1914 Discharged November 30, 1914

June 30, 1914 Appendicectomy and drainage for acute gangrenous appendicitis and peritonitis. Shortly after this operation it became evident that the patient had developed an intestinal fistula. As there was rapid loss in weight, and as the adjacent skin was badly irritated, it was determined to sidetrack the intestinal contents from the fistula which appeared to be in the ileum.

September 16, 1914 Ileocolostomy and exclusion of fecal fistula by ligation of ileum, local anæsthesia. The peritoneum was opened through the left rectus muscle, and by means of a rubber catheter passed through the fistula the upper loop was readily identified. Owing to the extensive firm adhesions sufficient ileum could not be mobilized to allow of cutting through the gut and closing both ends and then performing an ileocolostomy. Consequently I performed a lateral ileotransverse-colostomy with sutures and excluded the fistula by tying off the ileum distal to the stoma with heavy silk ligature and infolding the adjacent gut over the furrow thus made.

Experimental work has shown that such an excluding ligature will cut through and nature will reanastomose the gut above and

below within ten days. Consequently, dreading this, on September 19, 1914. Closure of fecal fistula under local anæsthesia was attempted, despite the unhealthy condition of the excoriated skin. The opening in the ileum was fully one and one-quarter inches in diameter. In separating the gut at the mucocutaneous junction, the adherent adjacent loops of intestine were difficult to avoid. Accidentally one such loop was opened and its copious contents spilt into the wound. This was closed with catgut, and then the fistula was closed as in the previous case, transversely to the longitudinal axis of the intestine. Typical flaps were made and shifted so as to cover the accidental opening as well as the fistulous opening in the gut. It was difficult to cover the latter as well as the former with the broader flap.

September 22, 1914. No fecal leakage. Some necrosis of larger flap. Considerable purulent discharge and evident infection of plastic flaps.

October, 1914. Plastic has been successful in so far as there has been no leakage from the accidental opening of the gut.<sup>4</sup> The larger flap has not healed in near its lower edge, and, on lifting it up, one can see the original opening in the ileum. As no evidence of re-anastomosis was apparent, and as the patient was gaining in weight rapidly and all signs of local infection and irritation were disappearing, I determined to wait for some time before attempting a second closure operation. Fifty-two days after the exclusion ligature had been applied there was no sign of re-anastomosis, and, as local and general conditions were favorable, on November 7, 1914. Closure of fistula under local anæsthesia was carried out. In this operation the same steps were performed as at the previous operation. The fistula was circumcised, adjacent area of gut dissected free and then stoma sutured with catgut. The two original plastic flaps (one slightly enlarged) were again lifted and switched back almost into their original positions. The suture line in the bowel was well covered. No leakage occurred after the operation.

November 27, 1914. Patient was discharged completely healed and cured.

CASE III—F, fifty years of age. Luetic stricture of rectum. Patient has been suffering from a tight stricture of the rectum about two to two and one-half inches from the anus. Preliminary to attempting an operation upon the stricture, the patient was placed on antisyphilitic therapy.

February 24, 1915. A sigmoid colostomy was made. As a fair spur had been produced most of the stream was deflected from the

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<sup>4</sup> This loop was oread to anastomotic stoma.

rectum and the inflammatory condition above and at the stricture improved

March 30, 1915 A plastic operation could be performed on the strictured gut In planning this operation I desired to avoid the fistulæ which so regularly follow resections in the rectum, and to do so applied the same principles as those that underlie the fecal fistula operation described in these pages Instead of making the usual median incision to expose the rectum, I made a curved incision so as to obtain a large skin and fat flap to lay over the plastic in the rectum and to insure a long circuitous tract from the rectum to the skin, in case the rectal sutures did not hold The plastic was done on the posterolateral wall of the rectum on the side of the attachment of the pedicle of the skin-fat flap after removal of the coccyx The plastic consisted of a Y-incision of the rectum which was then sewed up as a V This brought a good-sized flap of fairly healthy tissue into the strictured ring Adequate drainage was provided As was to be expected, there was slight leakage from this suture line in the rectum, but despite this the long fistulous tract below the plastic skin-fat flap closed without any difficulty As the rectal lumen seemed adequate, admitting as it did the largest rectal bougies, it was decided to close the artificial sigmoid anus

June 9, 1915 Closure of sigmoid anus under local anæsthesia As in the previous cases the mucous membrane was separated from the skin and the adherent gut sufficiently liberated without opening the peritoneum, to allow of infolding the stoma with fine catgut Three or four interrupted infolding sutures were reinforced with a superficial continuous suture, placed as usual, transverse to the long axis of the intestine This was then covered with the usual skin-fat flaps raised from either side of the fecal fistula Firm dressing applied The closure remained complete and though the patient's bowels moved within the first two days, there was no leakage of intestinal contents The tip end of the narrower flap became superficially necrotic After separation of the small slough the wound rapidly closed

The success of this operation has no relation to the available peritoneal surfaces as the peritoneum is not used to insure the closure Moreover, even the presence of a moderate "spur" does not prevent the success of this procedure (Cases I and III), as the lumen of the intestine is broadened at the site of the fistula not only by using the transverse suture line, but also by the fact that that newly made anterior wall of the gut at the level of the closure is not firm and can give way, covered as it is by fat and skin and no fascia

## MUCOCUTANEOUS FECAL FISTULÆ

*Epicrisis* —A careful review of these three cases will convince even the most skeptical that in this comparatively simple procedure, based upon the principle analyzed at the beginning of this paper, a satisfactory method of closing fecal fistulæ of the mucocutaneous type has been developed, and that in this technic a mucocutaneous intestinal fistula can readily be closed without invading the peritoneal cavity and without running the risks usually involved by surgeons in their varied attempts to close those troublesome artificial stomata. The operation is simple, much more simple than the extraperitoneal operations of Smith and Coffey,<sup>5</sup> and apparently most effective.

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<sup>5</sup> ANNALS OF SURGERY, June, 1907

## AN ANATOMICAL STUDY OF FEMORAL HERNIA \*

TOGETHER WITH A REPORT OF SIX CASES OF INGUINAL HERNIA OF SPECIAL INTEREST  
THREE WITH PROTRUSION OF THE BLADDER

BY T TURNER THOMAS, M D.

OF PHILADELPHIA

INTERESTING herniæ are rather frequent in the surgical service of the Philadelphia General Hospital. All but one of the cases upon which the present report is based were operated on last year during a three months' service and that of Dr A C Wood, to whom I am indebted for the privilege of operating on and reporting the cases admitted to his service. I shall briefly report, first, the inguinal hernia with some important facts concerning bladder hernia, taken from Eggenberger's excellent paper and not generally accessible, and then present a brief anatomical study of femoral hernia.

CASE I—*Inguinal hernia with cystocele*. Man, fifty-eight years, admitted to service of Dr A C Wood February 20, 1914, with a right-sided, direct, inguinal hernia of about two years' duration. Bassini operation the following day. The sac was opened to facilitate the stripping of it from the surrounding tissues, during which there was seen to its inner side, in front of the spermatic cord, and not adherent to the sac, a very thin-walled cystic formation suggesting a hydrocele of the cord. It was not tensely filled and seemed to contain a serous translucent fluid which did not escape during the manipulations until it was opened. When a finger was introduced it passed downward and inward into a larger mucosa-lined cavity which was evidently that of the bladder. The opened hernial sac was then closed by gauze, a part of the bladder diverticulum cut away, and the opening in the bladder closed by catgut sutures which inverted the edges without passing through the mucous membrane. The Bassini operation was completed and a small gauze drain left in the inner angle of the wound down to the bladder sutures. Slight abdominal distention followed but soon passed away and the skin sutures were removed on the eighth day, the small, serum-discharging drainage sinus soon closing.

CASE II—*Inguinal hernia with partially descended testicle and vaginal process closed only at internal ring*. Man, forty-five years, admitted to insane department of Philadelphia Hospital,

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\* Read before the Philadelphia Academy of Surgery, May 3, 1915

## HERNIA

January 3, 1910, when it was noted that he had a right inguinal hernia. Of late it has been giving him trouble. It is the size of a closed fist, reducible, direct, and the testicle on that side is a little below the external ring. Bassini operation, February 23, 1914. After opening what appeared to be the sac of the hernia it was found to be empty and the finger did not pass into the peritoneal cavity but was stopped at the internal ring. Below the testicle projected into it. Flattened out, its width was about two inches. The hernia was behind it and the hernial sac separated from it by loose areolar tissue. Its unusually large lumen was evidently caused by its being spread out gradually during the growth of the hernia underneath to which it was adherent. We had here a so-called infantile congenital hernia in which one must cut through three layers of peritoneum before reaching the contents of the hernia, the first two being those of the unobliterated vaginal process and the third being that of the hernial sac. This condition is very rare, but a congenital hernia into a completely patulous vaginal process is frequently associated with an undescended testicle. The vaginal process in this case was divided just above the testicle, the upper part removed and the lower part closed above the testicle by catgut suture. The Bassini operation was completed as usual. Recovery was uninterrupted except for some swelling of the scrotum which disappeared later.

CASE III—*Sliding inguinal hernia*. Man, aged thirty-seven years, admitted to my service July 27, 1914, with a left inguinal hernia about the size of the closed fist, of about ten years' duration. Bassini operation July 31. The sac had a wide communication with the peritoneal cavity and contained a large mass of omentum. A considerable portion of the colon uncovered by peritoneum presented in the lower part of the hernia, a sliding hernia. The lower margin of the sac was cut away to its attachment to the colon, the protruding portion of which was turned into the abdominal cavity by suturing the upper margin of the sac to the posterior, extraperitoneal wall of the colon. Bassini operation completed and recovery uninterrupted.

CASE IV—*Inguinal hernia with small bladder protrusion*. Man fifty-seven years old, admitted to my service July 27, 1914, with a right direct inguinal hernia, about size of a goose egg. Bassini operation August 3, 1914. The sac was surrounded by much fat. In separating this from the sac on its inner side near the neck the adhesions were firm and their separation started more than the usual bleeding which led to the recognition of a small mass firmer than the fat which covered it. From its position on the inner side of the sac and its consistency it was decided that it could only be bladder, and it was not opened. When the neck of the sac

was closed by a catgut ligature and the rest of the sac removed, the stump with the mass retracted downward and inward under the rectus muscle toward the normal position of the bladder. The chief reason for deciding it to be bladder, however, was a previous experience with Case VI, which had been previously operated on. The Bassini operation was completed, the outer edge of the rectus muscle being also sutured to Poupart's ligament. Uneventful recovery.

CASE V—*Strangulated inguinal hernia, with early operation*. Man sixty-seven years old, a patient in the department for the insane suffering from senile dementia. Had a large, inguinal hernia on the right side, reducible until the morning of August 21, 1914, when it became painful and irreducible and vomiting set in. Operation the same afternoon. The inguinal tumor was hard, tense, tender, reddened and gave no impulse on coughing. The pulse was rapid and the skin covered by cool perspiration. The evidence seemed to show that there had been no bowel movement for two days. Bassini operation. When the constriction at the neck was relieved and the sac opened, much fluid escaped. The intestinal contents were of a dark red color which returned almost to the normal in about fifteen minutes. The Bassini operation was completed and was followed by an uneventful recovery.

CASE VI—*Recurrent right inguinal hernia associated with an overlooked bladder protrusion and with a femoral hernia on the same side*. Man sixty-eight years old, admitted to service of Dr A. C. Wood in the Philadelphia Hospital, March 9, 1914. Had the inguinal hernia 12 years when it was operated on in 1907. It recurred about three years ago. Has a femoral hernia on the same side. Operation March 11, 1914. Inguinal hernia first exposed and much scar tissue encountered in exposing the sac which proved to be that of a direct hernia. The spermatic cord which contained much fat was first freed from its bed with the sac, which was then isolated from the abundant surrounding fat, its neck ligated and the rest removed. The femoral hernia was then exposed after drawing the lower margin of the skin and fascial portion of the incision downward. Its sac was surrounded by and adherent to much fat which was stripped from the sac after opening the latter. After ligation of the neck and cutting the rest away the stump retracted upward under Poupart's ligament into the inguinal region. The stripping of the excessive fat from the sac of the femoral hernia and the removal of only the sac left much fat around and over the femoral vein. In clearing this fat from the pectineus fascia and muscle for the closure of the ring much difficulty was experienced in guarding against a possible wound of the femoral vein which lay under the fat. During this stage

## HERNIA

of the operation a hemorrhage was started which proved to be coming from a small opening in the wall of the vein. This was closed by a hæmostat and a lateral ligature applied. The pectineus muscle and fascia were then exposed and approximated to Poupart's ligament by two catgut mattress sutures. Attention was then directed to the inguinal portion of the wound, in the inner part of which was much oozing from what seemed to be a mass of fat. This was ligated in mass and the hemorrhage, apparently, controlled. The Bassini operation was completed, the outer edge of the rectus being brought down with the conjoined tendon by the sutures to the lower edge of Poupart's ligament. The dressings were applied and the patient returned to the ward.

I was still in the hospital an hour later when it was reported that the patient was doing badly. Internal hemorrhage was diagnosed and the patient returned immediately to the operating room. As only the wound in the femoral vein was suspected, only the superficial part of the wound was opened, the suture in the external oblique not being removed. A free exposure of the femoral vein and of the whole wound above and below Poupart's ligament showed no signs of bleeding and the wound was again closed. Intravenous infusion, enteroclysis and other stimulation were given. At noon of the following day, twenty-four hours after operation, only two ounces of urine had been voided. At 6 P. M. of the same day a catheter withdrew only five ounces of urine, which contained a considerable percentage of blood that could not be accounted for. The breath sounds over both lungs were very rough. Forty-eight hours after operation the breathing was dyspnoeic, and on auscultation harsh sounds and bubbling râles were heard. The patient died on the same day.

The autopsy showed a large collection of blood extending from the operative wound to the space of Retzius and deeper in the pelvis at the right side of the bladder, some being found in the peritoneal cavity. A ligature was found loosely encompassing a small portion of the top of the bladder on the right side. There was also a large amount of blood in both pleural sacs and blood-stained fluid in the pericardial sac, the origin of which could not be explained.

The reopening of the wound proved that the pelvic hemorrhage did not come from the operative opening in the femoral vein, which was then shown to be securely closed. The only explanation left is that the ligature which was supposed to grasp only a mass of fat encircled a small portion of the bladder which is very vascular, the veins being especially large. This ligature, probably, became loosened at the knot or by the pulling away from its grasp of the small included portion of the bladder, which has a



substantial layer of muscle This would account, also, for the blood in the urine At the time of operation I had not thought of the bladder being involved It was this case which led me to seek further information on bladder hernia and to make an anatomical study of femoral hernia

*Bladder Hernia*—There is a fair probability that the bladder in this case, as well as that in Case IV, had not passed out through the hernial orifice, and, therefore, was not actually a part of the hernia, although it was adherent in both cases to the inner side of the neck of the sac It was the starting of the hemorrhage during the separation of the firm fatty mass from the inner side of the sac in Case IV, which was operated on subsequently to Case VI, that led to the recognition of the bladder It suggests that the bladder may frequently be found adherent to the inner side of the sac of a direct inguinal hernia

One finds little attention given to bladder hernia, aside from the vaginal variety which is not considered here, in our books on surgery even in the large systems, and special studies do not appear frequently in the literature Eggenberger's paper,<sup>1</sup> published in 1908, reports 5 new cases seen in the previous ten years in Wilm's clinic and 105 new cases reported since Brunner's report of 182 collected cases in 1896 It is a fund of information on the subject upon which I shall draw freely in view of the fact that so little information is generally accessible In my 3 cases the bladder did not project into the hernial sac but in 2 it was closely adherent to the sac In only 1 of Eggenberger's 110 cases did the summit of a diverticulum of the bladder entirely covered by peritoneum project into the sac, making it a true bladder hernia Brunner found 5 in his 182 cases In 25 of Eggenberger's cases, the hernia was said not to have an associated sac Of the whole number there were 53 per cent indirect inguinal, 27 per cent femoral, 17 per cent direct inguinal, with 2 in the linea alba and 1 in the peritoneum The usual size of the portion of bladder involved is that of a cherry to that of a walnut, rarely being as large as a hen's egg or involving half of the bladder The ureter has been observed in the hernia In only one of my cases was the bladder abnormally thin, as far as I could determine, and in that one it was exceedingly thin Eggenberger says that the diverticulum may have one or two muscle layers or merely the mucous membrane, and its wall be so thin as to be mistaken for the hernia sac, which would apply to my case if it were not for the fluid the diverticulum contained Notwithstanding this retention the finger later easily passed through its communication with the bladder In Tedenat's case the diverticulum contained pus

## HERNIA

which was not found in the urine, although boric solution was forced into the diverticulum from the bladder. Karewski found the communication so small that after the diverticulum had been opened, fluid could not be forced into it from the bladder.

In the other 2 of my cases the bladder protrusion gave the impression of a mass of fat unusually firm. In the reported cases the herniated portion of the bladder was often surrounded by fat which had to be gone through or removed before the bladder was exposed. Frequently a real lipoma was encountered. Monod and Delageniere as well as Lotheissen considered the prevesical lipoma as a constant sign in bladder hernia. Only in exceptional cases was the absence of the fat expressly noted. The percentage of bladder hernia found in all herniæ operated on varied from 1 to 3 per cent, although Becker in 30 cases found it 26 per cent. Lotheissen said that the number observed depends upon the special attention of the operator and the method of operation, the Bassini operation being especially favorable to their exposure. In one of mine it was discovered by the escape of urine during operation, in one at autopsy, which was responsible for my finding it in the third at operation. All three were found during the Bassini operation. In only 2 of Eggenberger's 110 cases and 18 of Brunner's 182 cases, was the bladder hernia recognized before operation.

Incarceration of the bladder by the hernial orifice sometimes occurs. It does not produce the clinical picture of an intestinal incarceration, although it is similar and easily distinguishable by the colicky pains in the region of the hernia or radiating to the thigh, disturbances of micturition, long continued retention, frequent tenderness over the hernia, and occasionally blood in the urine. Reflex gastric colic and vomiting and other reflex irritative symptoms are not infrequently present. Eggenberger believes that intestinal obstruction is not likely to occur, although in one case there was said to be no stool for eight days and fecal vomiting for four days before operation, while at operation only incarceration of the bladder was found.

Of the 45 of his 110 cases in which the presence of the bladder was first recognized during the operation, and was not wounded, only one is reported to have died. In 39 cases in which the bladder was first recognized after being wounded and was then sutured, 3 died. In 9 cases in which the bladder was wounded during operation and overlooked, 4 died. The recognition of the bladder during the operation, therefore, becomes important and is easy enough if its presence is suspected. The failure to separate the sac from the tissues on the

inner side as easily as usual and the presence of a more or less adherent lipoma, should excite suspicion. In palpating the mass one may get the feel of two mucous surfaces moving on each other. In most cases the end of a catheter introduced through the urethra can be made to pass into the diverticulum and can be felt through its walls. If this fails the diverticulum may be distended by boric or other solution injected into the bladder. The color and feel of the bladder, if exposed, as well as its continuation in the direction of the normal bladder, will suffice for diagnosis. The fatty accumulation here should receive attention. If the bladder is unexpectedly opened the escape of urine and even if no urine escapes the passage of a catheter will establish a communication with the bladder. If the cystocele is not wounded during an incomplete separation from the sac, it may be included in the ligature of the sac and a part of the bladder be cut away with the sac. The bladder, during a contracture, may then slip out of the ligature and the opening in the bladder may not be detected.

The diagnosis after operation may be made by the occurrence of hæmaturia or anuria soon after the operation, by a temporary urinary infiltration of the wound and fistula formation, or by the development of peritonitis from the presence of urine in the peritoneal cavity. In two of Eggenberger's cases, a second operation was done in time and the bladder wound sutured. The use of a truss is contra-indicated in all cases in which the presence of a cystocele is recognized, because the hernia is usually irreducible and the truss causes irritation, tenesmus, pain, and leads to inflammation and even gangrene. Small cystoceles found first at operation were repeatedly allowed to remain after being reduced without special treatment. If the bladder has strong adhesions to the sac, it is advisable not to attempt to separate them but to cut away the sac to the bladder, close the sac opening by sutures and reduce the cystocele with the sac. The partly changed bladder wall should restore itself to the normal later. The herniated portion of the bladder may be so thin or friable as to require its excision and closure of the opening by sutures, when a drain should be placed down to the suture line in the bladder. If a secure suture cannot be placed on account of the friability of the bladder wall, the edges of the bladder opening can be sutured to the external wound and drained. If after the operation the urine escapes into the operation wound and not into the peritoneal cavity, a fistula forms and usually closes in three to five weeks. To avoid urinary fistula after bladder suture, a permanent catheter in the urethra is serviceable. In the 39 cases in which the bladder was wounded during operation, the permanent catheter was

employed in 19, a fistula forming in 4. Of the 20 cases in which the permanent catheter was not used, 2 died in consequence of unretentive sutures and 7 developed temporary fistulæ.

*Femoral Hernia*—The most essential knowledge of this as of any other hernia concerns its anatomy. But the anatomy of this hernia has been so thoroughly studied and so long established that there would seem to be little profit to be expected from studying it further. Its anatomy, however, was established in the days when operations were rare or not done at all, and was based upon theoretical considerations, chiefly. Except for the femoral ring, which I think is the only important part, the canal is made up of a very weak fascia, and in those cases in which the femoral vein is in close contact with Gimbernat's ligament, there can be no femoral canal. It is the innermost compartment of the femoral sheath and its fascial wall is so thin that it can be traced with difficulty. The only practical purpose it ever served, so far as I can learn, is to explain the peculiar course of a femoral hernia, which is first downward under Poupart's ligament, then forward through the saphenous opening, and then slightly upward. That there is a much simpler and more satisfactory explanation for this course and that the femoral ring is very important and the rest of the canal unimportant, will be one of the chief purposes of my study to show.

To study the anatomy of femoral hernia a formalin hardened body is much better than one prepared in the usual manner, because in the former the structures shown by dissection will better maintain the position they occupied in life. The structures most liable to variation are the femoral vessels, because in life they were filled by a fluid which has largely disappeared after death, especially the vein, because of its larger calibre, more flaccid walls and its adjacency to the site of the femoral hernia which is under study, and is disturbed most by the dissection. In none of the formalin hardened specimens, here illustrated, which are from the department of applied anatomy of the University of Pennsylvania, were the veins distended by injection after death, although the arteries were employed for the injection of the preserving formalin solution. Such collapse of the walls of the vein as did occur disturbed very little its relation to the femoral ring, so that we have in these specimens a fair demonstration of the actual condition of the ring in life and the formation of its boundaries, as well as of some of the variations that may be expected.

Modern illustrations made by skilful artists will best emphasize the features of an anatomical illustration, but they are not convincing when there is doubt concerning the accuracy of the anatomy illus-

trated The camera would be much more effective if it did not confuse by the mass of unimportant detail and by its failure to bring all parts of the specimen into proper focus Because of the defects of the camera it will be important to fix attention on the very small part of each illustration under study, the femoral ring or the relation of the femoral vein to the margin of Gimbernat's ligament A preliminary general study of each illustration will help in making it serve the purpose for which it was intended

The following reasons for the peculiar course of a femoral hernia have been taken from standard works on surgical anatomy (1) Slight curve in femoral canal with its concavity forward, (2) narrowing below of the portion of the femoral sheath forming the femoral canal, and the unyielding nature of its adhesion to the lower margin of the saphenous opening and the cribriform fascia, (3) constant flexion of the thigh, (4) traction of the mesentery, (5) the superficial blood-vessels (chiefly veins) and lymphatics descend to the saphenous opening, the veins to join the saphenous vein and the lymphatics to the deeper lymph-nodes, the looping upward tending to suspend a femoral hernia and thus prevent its further progress downward Let us consider these reasons, briefly, in order (1) The canal is said to be only a half to three-quarters of an inch long, so that it cannot have much of a curve (2) The fascial wall of the canal is so thin and weak that it can be found only with difficulty Regardless of any adhesions it may have, it can offer little or no resistance to the progress of the hernia (3) Flexion of the thigh should push an inguinal hernia forward and upward if it does so with a femoral (4) Traction of the mesentery should be no greater than in an inguinal hernia which frequently descends to the bottom of the normal scrotum and sometimes much lower (5) The blood-vessels referred to (superficial epigastrics) lie external to the course of a femoral hernia and cannot obstruct it, while the lymphatics are so small as hardly to be worth considering The following explanation, in my opinion, is much more simple and satisfactory and will be best illustrated by the left side of the body shown in Fig 2 The model illustrated in Fig 3 will also be of service

As soon as they pass through the femoral ring, with its three unyielding sides, the hernial contents immediately re-expand This expansion takes place in all directions except backward, in which direction it cannot expand because immediately behind the hernia is the pectineus muscle resting directly on the pubic bone (see Figs 4 and 5) Only the skin and weak fascia resist anteriorly so that the whole antero-posterior expansion is forward, and the central axis, therefore, curves

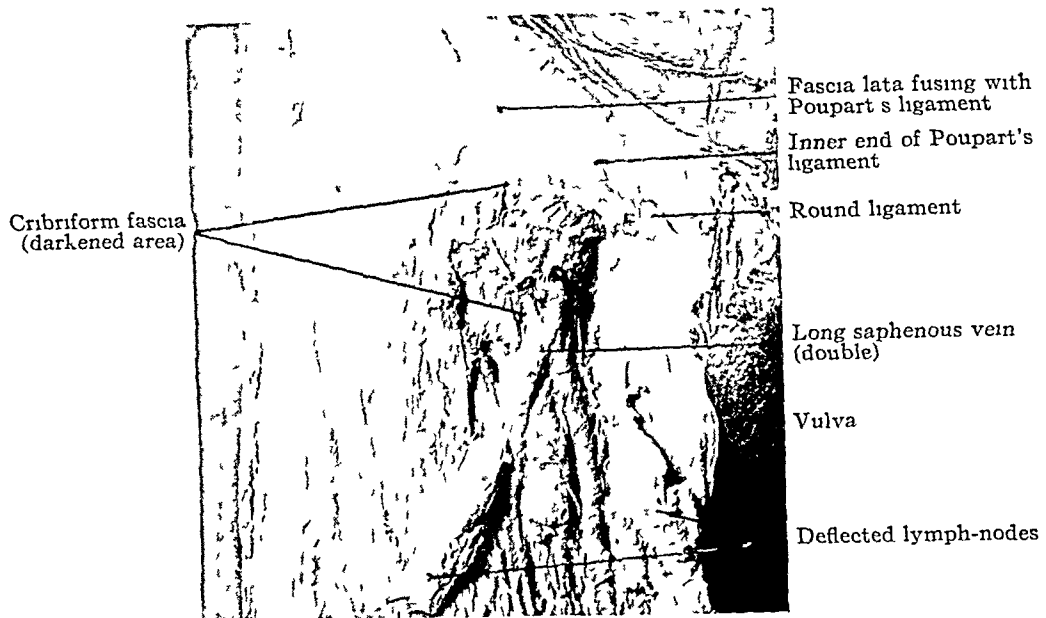


FIG 1 —Right groin. Skin and superficial fascia removed. Fascia lata fuses with Poupart's ligament and becomes thin (cribriform fascia) where perforated by saphenous vein. Saphenous opening must be made by dissector's knife or scissors. Lymph-nodes which covered cribriform fascia have been deflected.



FIG 2 —Regions of inguinal and femoral herniæ on both sides of body. On right side fascia lata exposed with removal of cribriform fascia making saphenous opening. Lymph-node resting against femoral ring but not passing through it as shown in Fig 10. Portion of external oblique muscle turned inward leaving Poupart's ligament internal oblique and spermatic cord in normal positions. On left side fascia lata removed exposing Scarpa's triangle with its contained structures in normal position. Only Gimbernat's ligament has been touched by paint brush to emphasize absence of any space between it and femoral vein.



FIG 3 —Taken from a museum model of a strangulated femoral hernia in the University of Pennsylvania. The small size of the hernia, the single loop of intestine and the turning forward of the hernia are characteristic. The turning upward is probably exaggerated. The color of the intestine indicates strangulation.

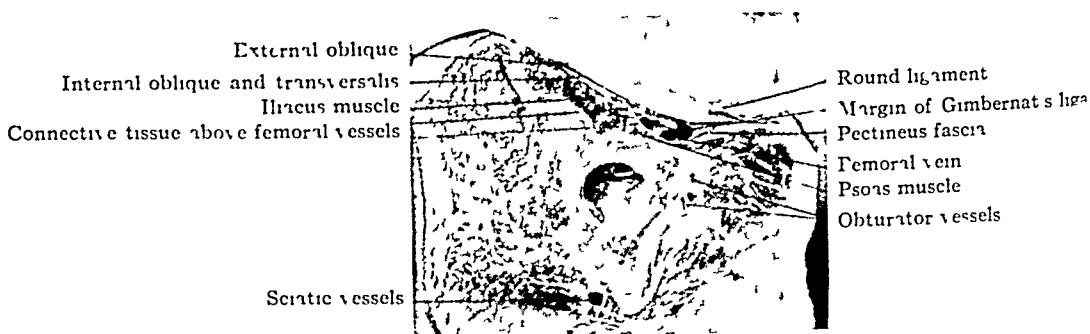


FIG 4 —Cross section of thigh at its junction with abdomen, a little above outer half of Poupert's ligament. Femoral ring unusually large partly because of small femoral vein. Space between Poupert's ligament and pubic bone almost entirely filled by iliacus and psoas muscles with anterior crural nerve between the two. Boundaries of femoral ring shown clearly. Pectineus muscle seen under ring when viewed externally, but not when looked at from inside (see Fig 8) because the pectineus ends above at the margin of the ring.



FIG 5 —Cross section of thigh at its junction with abdomen as in Fig 4. Inner portion of thigh cut longitudinally to save the penis and scrotum. Femoral vein larger than in Fig 4 and in intimate contact with margin of Gimbernat's ligament so that in such a patient no femoral ring exists until a hernia comes through and pushes the vein outward.

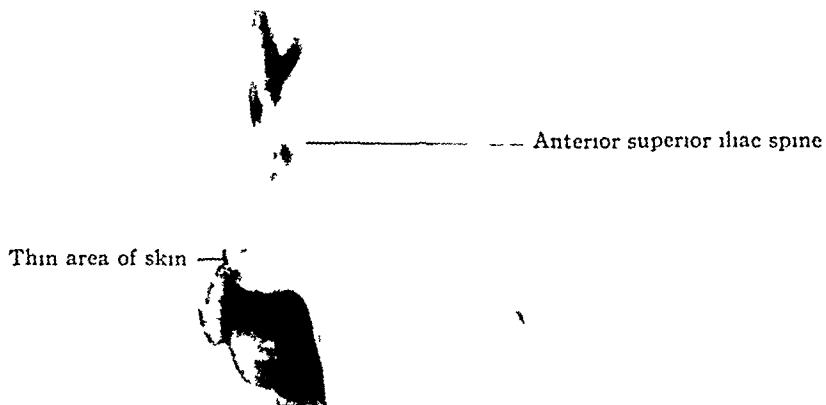


FIG 6—Case VII. An unusually large femoral hernia. It clearly does not turn upward, although in its upper part it overlaps Poupart's ligament. The darkened area of skin over the most prominent portion was very thin and became the apex of a conical tumor when the patient coughed.

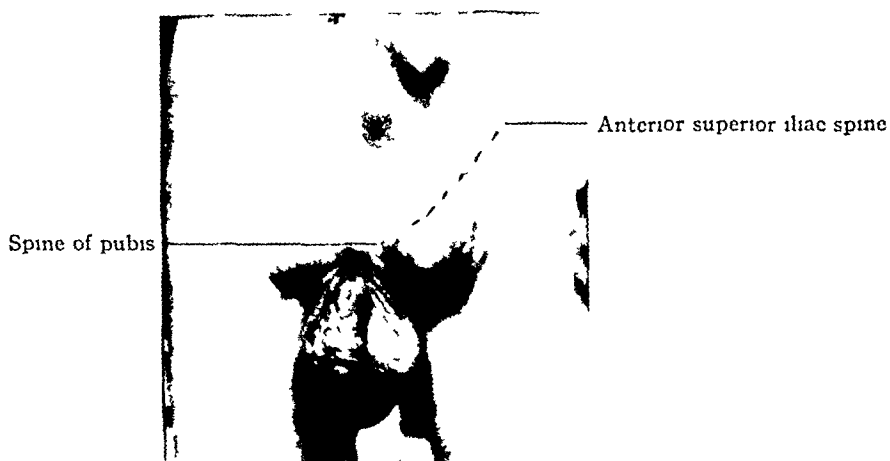


FIG 7—Case VII. More clearly shows that most of the hernia is below Poupart's ligament.

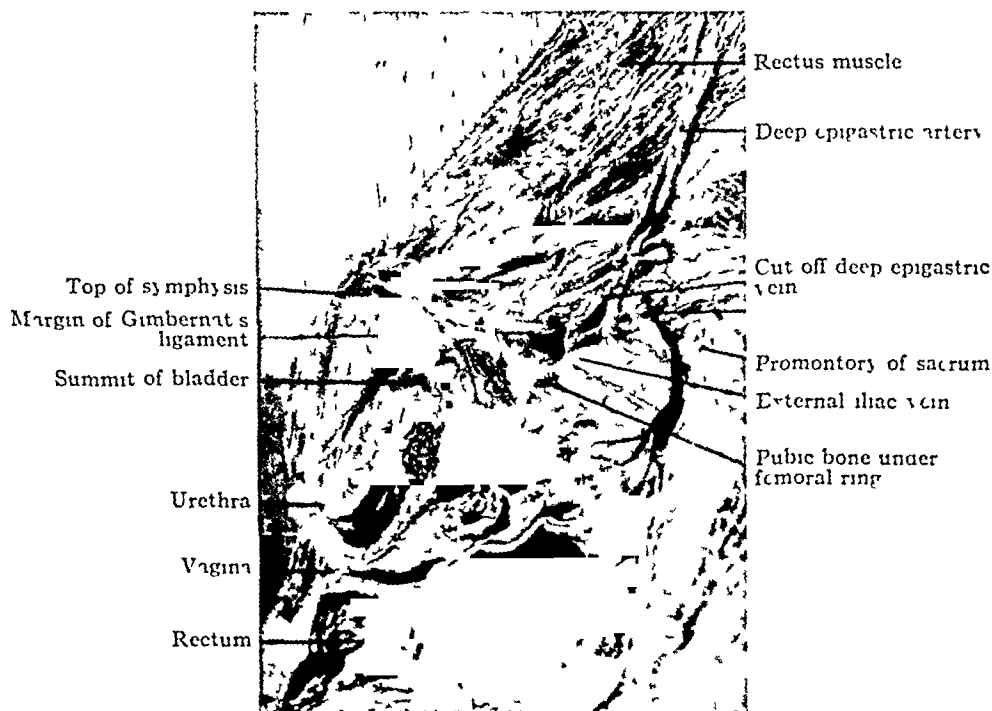


FIG 8—View from inside of specimen shown in FIG 4. Lower boundary of femoral ring now seen to be the pubic bone. Wall of the small femoral vein seems to have fallen away slightly, enlarging the ring still more.



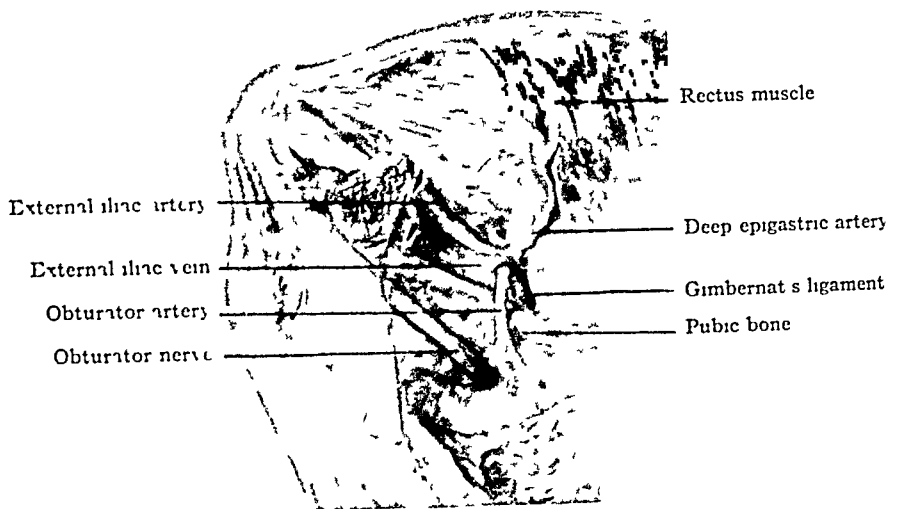


FIG 9 —Inside view of left half of specimen shown in Fig 2. Absence of femoral ring again shown by close contact of femoral vein with Gimbernat's ligament. It was particularly difficult to obtain a satisfactory picture of this specimen from the inside. This side has been emphasized slightly by the artist.

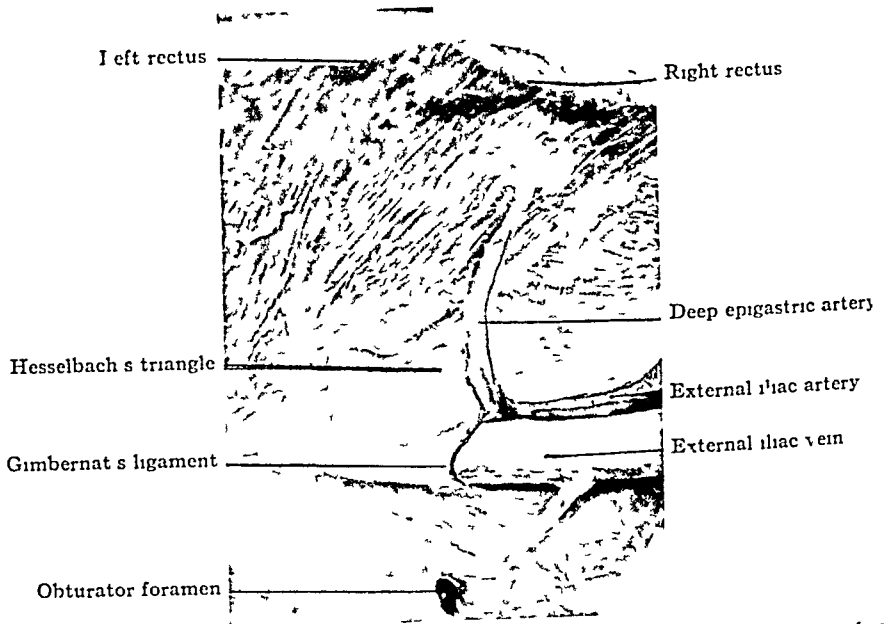


FIG 10 —Inside view of right half of specimen shown in Fig 2. Margins of the vessels and Gimbernat's ligament emphasized slightly by the artist. No actual femoral ring here and lymph-node seen on this side in external view (Fig 2) not seen on inside.

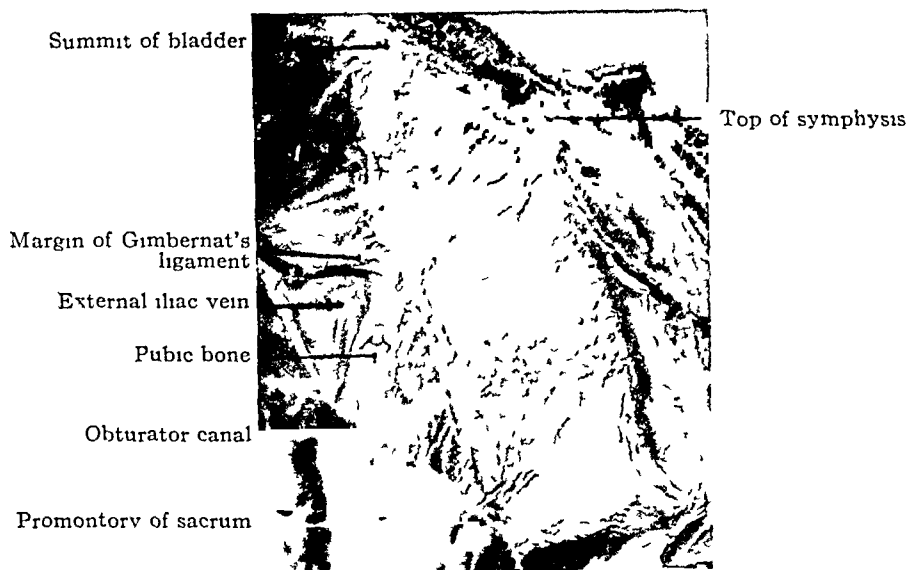


FIG 11 —Left half of male pelvis looked at from right side and posteriorly Rest of picture sacrificed to focus attention on femoral ring Bladder in this specimen rises more than an inch above the top of the symphysis pubis Normally it is at or below this level It is also seen to extend close to the femoral ring and inguinal canal the inner end of which is just above the femoral ring so that the bladder might find its way into a femoral or a direct inguinal hernia



FIG 12 —Right half of same pelvis shown in Fig 11 Femoral ring filled and perhaps effectively plugged by a lymph node Enlarged bladder again evident Abnormal fold in abdominal wall above due to bending it forward



FIG 13 —Right half of pelvis showing femoral ring covered over by the obturator artery and vein which are coming from the deep epigastrics These might effectively prevent the development of a femoral hernia On lifting these vessels and exposing the femoral ring the margin of Gimbernat's ligament was found separated from the vein about a quarter of an inch Much thickened bladder probably due to its complete collapse



forward I believe that this central axis does not curve upward, but that the expanding mass simply overlaps Poupart's ligament above (see Figs 6 and 7), because the narrow neck is just below Poupart's ligament and is curving forward. The intestinal loop in Fig 3 does curve upward, but we should bear in mind that this represents only a model made to show what some surgeon wanted it to show. Such an intestinal femoral hernia without accompanying omentum is probably uncommon. Rarely the hernia will force its way backward slightly by separating the fibres of the pectineus muscle (see Figs 2, 4 and 5). This is known as the hernia of Cloquet. Very rarely the hernia escapes outside of the femoral vessels and then is usually also in front of them. Still more rarely it may come down behind the vessels.

The small size and infrequency of the femoral as compared with the inguinal hernia, in all probability is due to the small space through which it must escape from the abdomen and the unyielding margins of this space on three sides. It is a little difficult to understand why the femoral vein does not suffer more from the pressure of the hernial neck with swelling of that limb, as it is on the only side of the neck which can yield much to the pressure. It is likely that it is aided by the attachments of its fascial sheath to Poupart's ligament above and the pubic bone below in accommodating itself to its crowded condition. The size and character of the opening have an important bearing, also, on the nature of the hernial contents. Not infrequently, writers refer to the contents as though they were usually omentum and intestine or one was present as frequently as the other, Da Costa,<sup>2</sup> however, says that femoral hernia contains omentum, but rarely intestine, except in strangulated cases. My study of femoral hernia seems to support this statement, and leads me to regard it as a particularly dangerous hernia because at any time intestine may escape and cause strangulation. The ring may be unusually large, as in Fig 4, and the intestine escape strangulation. Thomson and Miles<sup>3</sup> say that the hernia is often as small as a cherry or a pigeon's egg and may contain only a small tag of omentum or a portion of the circumference of the bowel—Littre's hernia. Large herniæ containing several coils of intestine are sometimes met with. In my group of cases intestine was not present when the sac was opened in any, except the two which were strangulated, and in both of these a small single loop was surrounded by a much larger mass of omentum. This suggests that both were purely omental until the escape of intestine caused the strangulation. The probability is that in most cases, as soon as the wall of the intestine gets into the ring its circulation is dangerously restricted by the pressure and that

strangulation is present either before the whole circumference of the bowel can escape or soon afterward, so that more than a single coil is rarely met with. The surgeon knows how difficult it is, frequently, to prevent the escape of very small portions of the omentum between the stitches while closing the peritoneal layer of an abdominal incision. He, therefore, knows that omentum can escape through a very small opening and may not suffer much from the constriction. But all of the omentum would not make a very large hernia, and all of it could not escape without taking with it the transverse colon. In a recent case of strangulated inguinal hernia upon which I operated, the length of the hernia was about equal to two closed fists side by side and the diameter slightly larger than that of the fist, the contents consisted of almost all of the omentum and a considerable portion of the transverse colon. The mass of extruded omentum was about the size of that of the colon. Very large herniæ are, therefore, made up chiefly of intestine, and a femoral hernia usually remains small because only omentum in varying quantity can come through or the early constriction and strangulation of the first loop of intestine prevents more from escaping. This is particularly true because the neck of the hernia is usually already filled with omentum before the intestine comes through.

Akerman,<sup>4</sup> in 1889, reported 235 cases of gangrenous intestinal hernia operated on in the Swedish Hospitals, and in 1913, 664 new cases, making a total of 899 cases. Of these, 214 were inguinal, 658 femoral, 13 umbilical, 7 ventral and 7 obturator. The femoral were slightly more than three times as frequent as the inguinal and the proportions of all kinds varied very little in the two groups of cases, which contributes to the reliability of the proportions since they are made up from cases operated on at different hospitals and by different surgeons. Von Bergmann and Bull<sup>5</sup> quote the following authorities on proportions of inguinal to femoral, in strangulated herniæ: Bryant, 50 to 44, Gosselin, 113 to 104, Maydl, 159 to 132, Henggeler, 111 to 159. Deaver and Ross<sup>6</sup> recently gave them as 77 to 50. The total number of cases in this group is 999, or 510 inguinal and 489 femoral. But Akerman reported only cases in which gangrenous intestine was found, while this group includes all strangulated herniæ. A pure omental femoral hernia may become strangulated but this is probably rare. One in an elderly hemiplegic woman came to autopsy at the Philadelphia Hospital recently. Many strangulated herniæ are now operated on before gangrene sets in but, owing to the smaller space and sharp, rigid margin of Gimbernat's ligament, gangrenous intestine may be expected earlier and more frequently in femoral than in inguinal hernia. Coley<sup>7</sup> says that of

75,535 cases of hernia admitted to the New York Hospital for Ruptured and Crippled Children, the relative frequency of femoral to inguinal was about as 1 to 17, which he says is the same proportion as that observed at the London Truss Society, according to the statistics of Macready. In 1720 operations for hernia, Sertoli<sup>8</sup> found 106 femoral and 1543 inguinal, or a proportion of 1 to 15. If we estimate strangulation in femoral as almost as frequent as in inguinal and the general proportion of inguinal as 15 to 17 times greater than femoral, the chances of strangulation are correspondingly greater in femoral. Intestine is very frequently present in inguinal hernia, and DaCosta's observation that it is rarely present in femoral, except in strangulated cases, is probably correct. If all inguinal herniæ are 15 to 17 times more frequent than all femoral, intestine very frequently present in inguinal and rarely in femoral, and strangulated femoral almost as common as strangulated inguinal, then intestine escaping into a femoral hernia will rarely escape strangulation.

There were said to be 116 Littre's herniæ in Akerman's second group of 664 gangrenous intestinal herniæ (154 inguinal and 487 femoral), but his report does not show their relative frequency among the different varieties of hernia. A Littre's hernia is one in which only a part of the circumference of the bowel escapes, *i e*, in Akerman's cases, strangulation occurred before the whole circumference of the bowel could get through the constricting ring. The presence of a small single loop is characteristic of a strangulated femoral hernia because of the small space through which it must pass and the rigid and sharp margins of the ring, as shown by the illustrations. Strangulation is more frequent, relatively, in obturator hernia because the obturator ring has still more rigid margins and is not capable of being enlarged as much as the femoral ring. These facts support the suggestion that intestine will rarely escape through the femoral ring without becoming strangulated, and that, therefore, all femoral herniæ are dangerous because intestine may escape on any severe strain. When the femoral ring is large, as in Fig 4, there may be little danger of constriction, but such large rings are probably the exception and not the rule.

The diagnosis of a femoral from an inguinal hernia is sometimes difficult. In four of this group inguinal hernia had been diagnosed. Some years ago a group of young surgeons debated the diagnosis in the case of a boy. It was finally decided that it was probably an inguinal hernia. I had the privilege of operating on this case and it proved to be a femoral. The tendency has seemed to be to diagnose inguinal, when

in doubt, because, owing to the greater frequency of inguinal, the chances are in its favor. According to my experience, if the diagnosis is difficult the hernia is likely to prove to be a femoral. It is more easy to demonstrate that an inguinal hernia is above Poupart's ligament than that a femoral hernia is below, because the latter pushes forward immediately below the ligament and its upward expansion covers and obscures it (see Figs 6 and 7), while an inguinal hernia makes the ligament rather more distinct than normal. In the male, the external inguinal ring can be felt by invaginating the scrotum, in the absence of a hernia, and when it has been enlarged by a hernia it is more easily recognized. Examination of this ring is a valuable aid in determining if the hernia is inguinal or not. But it is much less easy to feel the external ring in a female in whom femoral hernia is much more frequent, and it is not easy to feel the margins of the femoral ring when a hernia has been reduced through it, especially if the patient is fat, as many of them are. When there is little fat it is not difficult to recognize that the tip of the finger sinks into an abnormal depression, at the site of the femoral ring, just below Poupart's ligament and well outside of the spine of the pubis. When there is much fat, the patient a female, the hernia irreducible, and the external inguinal ring cannot be felt, it may be very difficult to positively diagnose a femoral hernia. During the past fifteen years, it has been my privilege to examine a large number of hernia, especially at the Philadelphia Hospital, and this experience has taught me that it is best, when the diagnosis is doubtful, to regard the hernia as femoral until I can prove that it is not. The best evidence in favor of its being femoral is that most of the tumor lies below the approximate line of Poupart's ligament (an inguinal is distinctly above), that it is well outside of the pubic spine (the spine can be felt outside of an inguinal hernia), and when the hernia is reduced the finger can usually be pressed into a depression just below Poupart's ligament.

The great danger to which hernia patients are exposed is that of strangulation, and the risk is greater in femoral than in any of the other common forms. Obturator hernia is comparatively more frequently strangulated than femoral but is not as common a hernia. So long as a femoral contains only omentum there is probably little danger of strangulation, but a knuckle of gut may escape at any time and bring on strangulation. Akerman discussed, chiefly, the results of operation for gangrenous intestinal hernia which were bad, v Bergmann<sup>9</sup> says that there is little reason to expect a favorable result from taxis in strangulated femoral hernia and that one should advise

against it and in favor of radical operation. Since the patient is always in danger of the escape of intestine and the development of strangulation, the best treatment is to prevent gangrenous hernia by operating before strangulation occurs. Operation in this stage has a very low mortality and recurrence of the hernia is rare. Many different operations have been performed in comparatively recent years. Ochsner<sup>10</sup> enumerated 20 and Sprengel<sup>11</sup> (quoting Goebel) 50. The plastic operations for filling the canal by muscular, periosteal, osteoperiosteal and heteroplastic flaps are wrong in principle, in my opinion, and have had little support, while the simpler operations prevail. Ochsner says that removal of the sac without closure of the canal will cure all cases. While I added one or two mattress sutures to close the ring, I found much in my anatomical study to support Ochsner's radical statement. With proper regard for the femoral vein the operation becomes almost a minor one. The hernia is almost subcutaneous, no muscles are divided and the peritoneal cavity is barely opened. The placing of one or two mattress sutures to approximate Poupart's ligament to the pectineus muscle and fascia adds little or nothing to the danger of the operation, the early performance of which in practically all cases would involve much less risk than taking the chances of intestine or bladder escaping through the ring and causing strangulation.

If the sac is separated from the margins of the ring on all sides, drawn down and the ligature placed as high as possible, the stump will retract or can be pushed upward into the abdomen, when nothing will intervene between the femoral vein and the remaining margins of the ring. The anatomical illustrations show that the femoral vein must have been pushed outward by the hernia away from the curving margin of Gimbernat's ligament. When the hernia has been entirely removed the femoral vein relieved of this pressure should soon find its way back to its normal position, close to or in contact with the margin of Gimbernat's ligament. The vigorous contractions of the very active iliacus and psoas muscles should be important factors in forcing the vein against the ligament, since they almost completely fill the space between Poupart's ligament and the underlying pubic bone (see Figs 4 and 5). The effect of sutures forcing Poupart's ligament down to the pectineus muscle would be to compress the vein and thus force it into closer contact with the remaining margins of the ring. The introduction of tissue of any kind, as bone, muscle, etc., into the ring would not close it more effectively but would only serve to permanently displace the vein from its normal position. Cicatricial adhesion of the vein to the remainder margins of the ring would be more effective in pre-



venting a recurrence of the hernia, since it is just this relation which best prevents the first development of the hernia. A purse-string suture would accomplish the same purpose as the mattress sutures but has no advantages over them.

The usual method of exposing the sac, separating it from the surrounding fat, and after ligating its neck cutting it away, leaves the ring and the femoral vein covered by a confusing mass of fat which is retracted with some difficulty and makes the exposure of the pectineus muscle and fascia and protection of the vein rather troublesome. The normal fat of this region is considerably increased by the preperitoneal fat pushed out with the sac and left here after the sac has been removed. I have found it advantageous to remove a thick layer of fat with the sac, so that the later exposure of the margins of the ring, femoral vein and pectineus muscle becomes less troublesome. In my opinion, the vertical has advantages over the transverse incision. In its upper part the external oblique aponeurosis is quickly exposed and its lower border, Poupart's ligament, easily outlined. This is an excellent landmark. Just below it the neck of the sac with its surrounding fat can be seen, just external to which is the femoral vein. Removal of the adherent fat with the sac, high ligation of the neck with retraction upward of the stump out of the operative field, will facilitate the protection of the femoral vein and the passing of one or two mattress sutures to approximate the pectineus muscle and Poupart's ligament or the floor and roof of the ring.

Having had no experience with the method of closing the ring from the inside, through the inguinal canal, I can express an opinion based only upon my anatomical study and my experience with the ordinary closure of the ring from the outside. The illustrations showing the ring from the inside (see Figs 8, 9, 10, 11, 12 and 13) demonstrate that its lower boundary is the pubic bone. This is covered only by loose connective tissue and peritoneum. In exposing the ring for the placing of the sutures, most of the overlying connective tissue is pushed away, leaving only the periosteum and a little connective tissue to hold the sutures. I would not trust the needle to pass under the periosteum without cutting its way out, in which case the suture could have no influence in closing the ring. On the other hand, the obturator vessels not infrequently come from the deep epigastric and pass to the obturator canal over the internal surface of the ring, as shown in Fig 13. In most other cases pubic branches of the deep epigastric of considerable size have the same general relation to the ring as they pass to the pubic region. There are no such vessels to interfere

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with the exposure and suture of the ring from the outside, where the suture can take hold of the substantial pectineus muscle and overlying fascia forming the floor of the ring. This muscle arises at the bony margin of the ring so that the suture catches it immediately below the ring. The advantage, therefore, should be with the external operation.

CASE VII —Man, forty-four years old. Admitted to tuberculous wards of Philadelphia Hospital, December 6, 1913. Diagnosis of advanced tuberculosis of lungs and tuberculosis of intestines. Now has a hernia in the left groin. Says he was operated on in this hospital for a hernia on the left side during the past summer, and this is confirmed by the presence of a linear scar over the position of the inguinal canal. It was, therefore, assumed that we were dealing with an inguinal hernia recurring after operation and no further effort was made to establish the diagnosis. Transferred to surgical service of Dr. A. C. Wood, January 10, 1914. The size and shape of the hernia are shown in Figs. 6 and 7. During standing and coughing, which is severe, the hernia assumes a conical shape and the skin over the most prominent part is bluish in color and evidently very thin. The patient desires operation because, during coughing, he has the feeling that the hernia is about to burst, and it then looks as though it might do so.

*Operation* (January 12) —Under spinal anæsthesia, with 10 c.c. of a  $\frac{1}{2}$  per cent novocaine solution. The incision was made to expose an inguinal hernia. The skin was very thin over the most prominent portion of the hernia and was here very adherent to the sac. The external oblique and external ring appeared to be normal, no evidence of a scar of a previous operation being found in this muscle. The neck of the sac was found to be coming through the femoral ring. It afterward developed that he had been operated on for an abscess of the groin and no record of a previous operation for hernia could be found. The only contents of the sac found at operation was omentum, although my recollection of the way in which the hernia distended during coughing and its size led me to believe that it then contained intestine also. The neck of the sac was isolated as high as possible, drawn down and ligated as high as possible, and after removal of the sac the stump retracted upward. Two catgut mattress sutures were employed to approximate Poupart's ligament to the pectineus fascia and muscle in order to close the probably large ring. Silk-worm-gut sutures for the skin. Dressing. Primary healing. Firm pressure was maintained over the wound by adhesive strips and a spica bandage of the groin for five weeks. Notwithstanding

ing the continuous severe coughing no recurrence of the hernia had occurred up to the time of his death on December 9, 1914

CASE VIII—Woman, forty-six years old, well nourished Transferred to my service in the Philadelphia Hospital, July 4, 1914, from the nervous ward where a cervical myelitis was diagnosed On the right side, just below Poupart's ligament, is a hernia about the size of a hen's egg, which is easily reducible and had been diagnosed as an inguinal hernia The patient has been and is now complaining of much pain in the abdomen, particularly in the pelvic region A dilatation and curettement of the uterus had been done for the possible relief of the pelvic pain

*Operation* (July 10)—The patient requested that her abdomen be opened on account of her pain Trendelenberg position Pfannenstiel incision just above the pubis, and the abdomen opened and explored, but nothing abnormal found that would account for the abdominal pain Abdominal wound then closed up to and including anterior sheath of the rectus muscle Right end of skin and fascial portion of incision lengthened to region of hernia, the neck of which was easily outlined just below Poupart's ligament The sac with its adherent fat was separated from the surrounding tissue, opened and found to contain some adherent omentum which was drawn down and ligated high and cut away beyond the ligature, the stump retracting upward into the abdomen Poupart's ligament sutured to the pectineus muscle and fascia as in the preceding cases, and the skin incision closed with silkworm gut Uneventful recovery and no recurrence of the hernia up to the present time

CASE IX—Man, fifty years old, laborer Admitted to my service in the Philadelphia Hospital, July 30, 1914, with a hernia in the left groin about the size a small fist, which is reducible Femoral hernia diagnosed and operated on July 31

*Operation*—Vertical incision over hernia, exposure of external oblique first and neck of hernia just below Poupart's ligament Sac with adherent fat isolated, ligated high and removed as in preceding cases, and Poupart's ligament sutured to pectineus muscle and fascia Silkworm gut for skin wound Uneventful recovery and no recurrence up to present time

CASE X—Woman, sixty-nine years old Emaciation and wrinkling of face make her appear ten years older Admitted to my service, July 5, 1914, with a strangulated femoral hernia on the left side, and in a stuporous condition From a relative it was learned that the hernia had existed about four years For about four days before admission it had been irreducible and painful and after admission mild attempts at reduction by the

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interne were unsuccessful Operation the same day under local anæsthesia with a 2 per cent novocaine solution

*Operation* — Sac exposed by an incision parallel to Poupart's ligament, opened and found to contain a considerable mass of omentum and a single loop of small intestine about four inches long Both omentum and intestine were dark in color but neither was completely gangrenous, the intestine being a dark red Gimbernat's ligament was divided on a grooved director and the loop of intestine drawn out until healthy bowel was reached In doing this the inner limb of the loop gave way into the lumen at what was clearly the line of constriction by the sharp edge of Gimbernat's ligament and where the bowel wall was distinctly necrotic The omentum was also driven out until a healthy portion was reached and it and the intestine were sutured to the margin of the ring A portion of the omentum was removed, but the intestine was not resected because of the very weak condition of the patient The bowels were freely opened, but no fæces appeared until the following day, when they escaped freely The patient showed no signs of reaction after the operation and died two days later

CASE XI — Woman, fifty-seven years old Admitted to my service in the Philadelphia Hospital, August 7, 1914, with an irreducible right femoral hernia, which extended about six inches in the line of the groin and about two inches from above downward The patient is dull and semistuporous and her statements are hardly reliable The only apparently reliable answers she gave seemed to show that the hernia became irreducible about two weeks ago, that the bowels have not moved in that time and that she has not vomited The overlying skin is dark red in color and the hernia tense and very tender It is irreducible, there is no impulse on coughing and there is fluctuation in one part Diagnosis of a strangulated femoral hernia was made The patient is fairly well nourished, but there is a purulent discharge from both eyes and the left nostril Heart and lungs negative, abdomen much distended, and a small umbilical hernia which is apparently giving no trouble Operation soon after admission under local anæsthesia with a 2 per cent novocaine solution

*Operation* — Incision in long axis of hernia As soon as skin and subcutaneous tissue were divided, a small quantity of dark, grumous, foul-smelling material was evacuated The sac was thick and dark in color and when opened was found to contain a considerable mass of omentum and a small single loop of small intestine, both of which were distinctly gangrenous Gimbernat's ligament was carefully divided on a grooved director and the intestine and omentum brought out until healthy portions of

both could be sutured to the margins of the ring. A portion of the protruding omentum was cut away. The line of demarcation in the intestine was distinct. On the following day the gangrenous portion of the bowel was cut away and soon afterward fæces appeared in the wound. The patient did not react from her weak and semistuporous condition, although she lived for three days after the operation.

CASE XII—Medical student, twenty-four years old. While playing foot-ball about ten years ago, developed a severe pain in the right groin. A direct inguinal hernia was diagnosed at the time and at different examinations afterwards. I saw him July 6, 1914, and diagnosed a femoral hernia which was found at operation, two days later, at St. Agnes Hospital.

*Operation*—A longitudinal incision about  $2\frac{1}{2}$  inches long was made over the hernia, the sac exposed and opened but the neck was so small that a finger could not be passed through the ring, a grooved director being necessary for the purpose. The sac with its adherent fat was isolated, drawn down, ligated high and cut away, the stump retracting upward under Poupart's ligament. The pectineus muscle covered by its fascia was exposed and Poupart's ligament drawn down to it by one catgut mattress suture. Silkworm gut for the skin and dressing applied. Healing uneventful. He has since engaged in vigorous exercises without any sign of recurrence of the hernia.

*Conclusions on Femoral Hernia*—In femoral hernia we are concerned not with a canal as in inguinal hernia, but with a ring as in umbilical hernia.

The femoral hernia turns forward immediately after passing under Poupart's ligament, because it can expand only forward, the pectineus muscle lying on the pubic bone preventing any backward expansion. The upward expansion of the hernia overlaps and conceals Poupart's ligament, but the whole hernia does not turn upward. Occasionally it separates the fibres of the pectineus, posteriorly, and is then called a hernia of Cloquet.

A femoral hernia is usually small and comparatively infrequent, for the same reason that an obturator hernia is small and infrequent, because of the small ring and its rigid margins. The femoral ring is small or does not exist until the escaping hernia pushes the femoral vein away from the margin of Poupart's ligament, which it does with difficulty and for a small distance. Omentum gets through with difficulty and intestine is usually strangulated soon after it begins to come through. Most femoral herniæ are, therefore, omental until intestine escapes and causes strangulation.

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When the diagnosis between inguinal and femoral hernia is difficult, a femoral hernia will probably be present

All femoral herniæ should be considered dangerous because intestine may escape on any severe strain and cause strangulation. For this reason it is safer to operate on all femoral herniæ before strangulation than to take the chances of strangulation.

The hernia is subcutaneous, no muscles are divided, and the peritoneal cavity is barely opened. Simple removal of the sac will probably cure in the great majority of cases, but the approximation of Poupart's ligament to the pectineal muscle and fascia by one or two catgut sutures will add to the certainty of cure.

The vertical has advantages over the transverse incision, and the removal of a thick layer of the fat adherent to the sac favors the easier exposure and suture of the ring.

The closure of the ring by the external exposure and suture is safer, easier and more effective than by the internal exposure through the inguinal canal.

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# THE CLINICAL STATUS OF THE AUTOGRAFT\*

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THE growing literature on autogenous transplants reflects the interest of the profession in this phase of the most recent development of modern surgery. Notwithstanding the recent exploitation of this procedure, there are descriptions of pedicled autogenous transplantations antedating the Christian era, for instance, the Indian method of rhinoplasty where the tissues of the forehead were swung down to form the new nose.

As in the evolution of every science, art or craft definite lines of procedure or technic gradually crystallize out of the mass of experimentation. So, in surgery, at the present time, we have new operative methods, the result of clinical evolution, which has established accepted operative procedures, which now take their place alongside the classical operations, and by these procedures we build up or repair defects or injury of one tissue by utilizing the same tissue taken from a point remote from the lesion, or by tissue of other histological form.

The profession is unanimous that alien or heteroplastic transplantations are never successful—the differing serological and cytological relations between the differing animals precludes the survival of such transplants. There is not, however, such unanimity with regard to homotransplants, many observers reporting successful results from homografts of bone, fascia, skin, blood-vessels, joints, thyroid tissue, parathyroids, ovaries, etc. Yet there are dissenters, who believe the ultimate survival of the homograft, as such, is rare, probably these different views are due to the different perspectives of the clinicians and the pathologists, for what may be successful clinically may not so prove to be to the microscopist.

Even heteroplasty in a clean field may simulate a clinical success, for although the graft is absorbed or encapsulated, or the tissues of the host gradually replace it, a functional result may occur, hence the seeming confusion. Unquestionably some of the simpler transplants from humans or animals of the same species which are closely related or whose fluids and tissues are much alike may survive, while in other instances where dissimilarity exists, they will succumb. Parallel ob-

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servations have been made upon the blood of two individuals, one being hæmolytic for the other

The ideal condition for transplantation exists only when the graft is an autograft. Here the nourishing pabulum is the same for all of the tissues and an adaptation is unnecessary. The histology of the transplanted tissue has much to do with the success or failure of the transplant. The more complex or highly specialized the cells, the less are their chances for survival, for example, nerves, muscles, or parenchymatous cells, while the simpler tissues retain their vitality, such as fat, fascia and tendons.

The growth of tissue *in vitro* has borne out the clinical observation that the simpler tissues receiving their temporary nutrition by osmosis from the plasma can survive until their blood supply is re-established, while the more complex tissues need an immediate blood supply to support life. Assuming that the vascularization of a tissue is adequate, it must needs have work to do or special functions to perform if it is to survive and proliferate. This law is well emphasized in the growth of weight-sustaining bone to the needs of the limb and in the functional activity (for a time at least) of thyroid tissue in the presence of hypothyroidism.

An aseptic field and sterile plasma as a culture medium for a transplant, is necessary for successful transplantation, although bone and fascial grafts have shown rather a marked resistance to sepsis. Blood-clotting about a graft is a serious mechanical interference with the nutritive lymph reaching the graft, therefore absolute hæmostasis is imperative. An exacting technic which forbids the contacting of the gloved fingers with the wound, transplant, or instruments touching the operative field, and a minimum of instrumental contact with either, must be insisted upon, as only by such exaggerated care can success be obtained.

Early reports by Lexer and Tuffier of complete joint transplantations, where refrigerated joints of cadavers or amputated limbs were used, aroused the hope of the profession that this method would offer brilliant results. Two cases of elbow transplants were said by Tuffier to be satisfactory after the expiration of eighteen months. No later reports relative to them have been noted. Lexer describes one case of knee transplantation six years after operation. He says the joint was in no way normal and in appearance simulated that of arthritis deformans, also that the result was in reality that of pseudo-arthritis. In autoplasty, Buchman has reported transplanting the great toe joint into the elbow with fair results, while several surgeons have substituted



the patient's own toe-joints for his finger articulations, therefore, in view of the discouraging reports by the men who advocated joint transplantations, to most surgeons, arthioplasty offers much the greater attraction, both as to simplicity of technic, availability of tissues and ultimate success

The transplantation of bone which is clinically yielding such very brilliant results in the hands of nearly all surgeons, brings up the interesting problem now being debated with animation, namely, the question of the viability and regeneration of the graft

Dominating the many attractive theories are those advanced by Axhausen, Macewen and Murphy. The former affirms that the periosteum alone survives and regenerates bone, the second, teaching that the bone itself is osteogenetic, the periosteum acting simply as a limiting membrane to the osteoblasts, while the third believes that the graft or its periosteum has naught of inherent osteogenesis and retains only the faculty of osteoconductivity when contacting at one or both ends with living bone

A vast amount of experimentation has been done, much of which has served but to befog the question, as the results of one group of observers do not confirm those of another. One man is able to grow bone from free periosteum transplanted into the soft tissue, while another is not. In our own laboratories, Corbett has grown bone from free transplantation of periosteum of young animals only, never from adult periosteum. He has noted that bone and periosteum implanted into the abdominal region of rabbits has survived for two years, only to be then absorbed. We have yet to determine whether or not this bone would have survived indefinitely, if, according to the law of Roux, it had been given specific work to do.

To us there is something of truth in all of the theories as presented by Axhausen, Macewen and Murphy, probably a part at least of each of their theories is exemplified by the life cycle of a periosteal, endosteal and bone graft, for, after all, life, death or regeneration is entirely dependent upon the one need of vascularization.

Numerous observers have shown that small grafts with or without periosteum, offering a relatively large surface to the nutritive plasma will survive. They have also shown that 41 per cent of the large grafts without periosteum lived, while 100 per cent of the grafts with periosteum were viable. If the periosteum and endosteum offer greater facilities for vascularization, whenever possible, they should be utilized, although in several of our earlier grafts we had perfect clinical results without them. We believe that part of the cortex of the bone adjacent

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to the periosteum and the endosteum, receiving early, through these membranes, its nutrition from the lymph, may survive, while the deeper-seated bone, failing of nutrition, dies and is absorbed, only to be later regenerated from the inner layer of the periosteum with possibly the aid of osteoblasts derived from the contacting living bone

In two of our cases where bone was transplanted into an old infected field, the grafts survived, probably due to an established immunity. Lewis and others are deliberately transplanting autografts into cases of osteomyelitis with encouraging success. These results are certainly suggestive of an inherent osteogenesis. Suggestive of this as well are the reported facts of repair of fractured bone grafts with callus formation at the point of fracture, also of the sequestration and involucrum formation from a free bone graft in the presence of infection.

The many uses of bone grafts have been so freely detailed that we wish to speak of but one. If the bone transplant is exhibited for the repair of a non-united fracture, two methods of use are available—the inlay or the intermedullary insert—each has advantages, although there is 100 per cent of success by either method properly used. We have been impressed with the necessity of going wide of the eburnated sclerosed bone on the ends of the proximal and distal fragments of the fracture. This ivory-like bone has no osteogenesis and unless it is bridged with a living graft which contacts well above and below with viable bone, union will not result. A few surgeons have abandoned the use of the Lane plate, successfully substituting in its place the autogenous bone inlay, which is firmly fastened to the fractured fragments. The advantages of bone over metal are obvious.

Equally brilliant as in the transplantation of bone are the results from fascial grafts.

This tissue, also of the connective-tissue group, lends itself readily to a multitude of uses—its simple cellular construction, low vascularity and its easy accessibility make it ideal for transplantation. Lined with a layer of fat we have utilized fascia lata to fill a four-inch defect left by the removal of a cystoid scar of the dura. The tendency of the pia to form dense adhesions to adjacent tissues is here combated by the movable fat, which forms a hygroma and discounts these adhesions. Efforts are reported, where the peritoneal lining of a hernial sac or the sac of a hydrocele has been used for this purpose only to fail because of the dense adhesions formed.

In restoring the loss of tendons, we have reconstructed an entire extensor group in the forearm from the iliotibial band, then surrounded the bundle with a fascia and fat fillet to take the place of the annular

ligament of the wrist and prevent adhesions—this method gave a perfect functional result

It is in the strengthening of large ventral hernial repairs however, that the results have been illuminating. These great hernias occur frequently in very fat women who have usually a marked diastasis and atrophy of the recti from overstretching, and as well fatty degeneration of the aponeuroses. In these cases the fascial graft is valuable as there are either enough stresses and demands put upon it to stimulate hypertrophy, or it is replaced by a dense sheet of connective tissue which is itself supportive.

Lewis has experimentally reconstructed common bile ducts from fascial tubes, these grafts remained patent and survived in the presence of sterile bile. The restoration of ureteral defects has, as well, been undertaken by this method, with a resultant viable graft, notwithstanding the flow of urine over it, here, however, there is a loss of ureteral peristalsis, with ultimate stricture and hydronephrosis.

Free fascial grafts to cover suture lines in the œsophagus, stomach and bowels are reported as successful but have not the merit of the omental graft popularized by Senn. The occlusion of the pylorus by a fascial band is as satisfactory as any method of occlusion, except resection. Fascial slings have repeatedly been used in the suspension of prolapsed kidneys.

Where there is loss of a nerve trunk and the two ends cannot be approximated, a fascial tube joining the ends conducts the proliferating axons, in the regeneration of the nerve. This method has proved as useful as the transplantation of segments of other nerves, for these lose their axons and act simply as conducting tubes.

The clever work done in arthroplasties by Murphy has popularized the use of fascial and fat flaps to cover the ends of the denuded bones in the reconstruction of joints.

While the free graft is successful in the temporomaxillary, shoulder-, elbow- and wrist-joints, it should be replaced by the pedicled flaps in the weight-bearing joints, as here the greater pressure upon it determines the necessity for a better blood supply.

In one instance we had a great bridge of bone springing from the anterior surface of the humerus under the brachialis anticus and bridging and locking the elbow-joint. After its removal, we swung in a flap of aponeurosis to cover the large area left bare of periosteum, hoping this graft would act as a limiting membrane and prevent the reformation of the exostosis. At the end of ten months, however, the bone partially reformed, it was again removed, the fascial graft was found



FIG 1 —Non-union of both bones of forearm, showing futile use of Lane plate



FIG 2 —Union of 'A' following intermedullary bone graft



FIG 3 —Non union following exhibition of intermedullary bone graft The graft was not driven far enough beyond the sclerosed bone



FIG 4—Same case as Fig 6 showing union after bone inlay which bridged the sclerosed bone



FIG 5—Recurrent exostoses of olecranon and lower end of humerus notwithstanding the use of fascia lata to take the place of periosteum

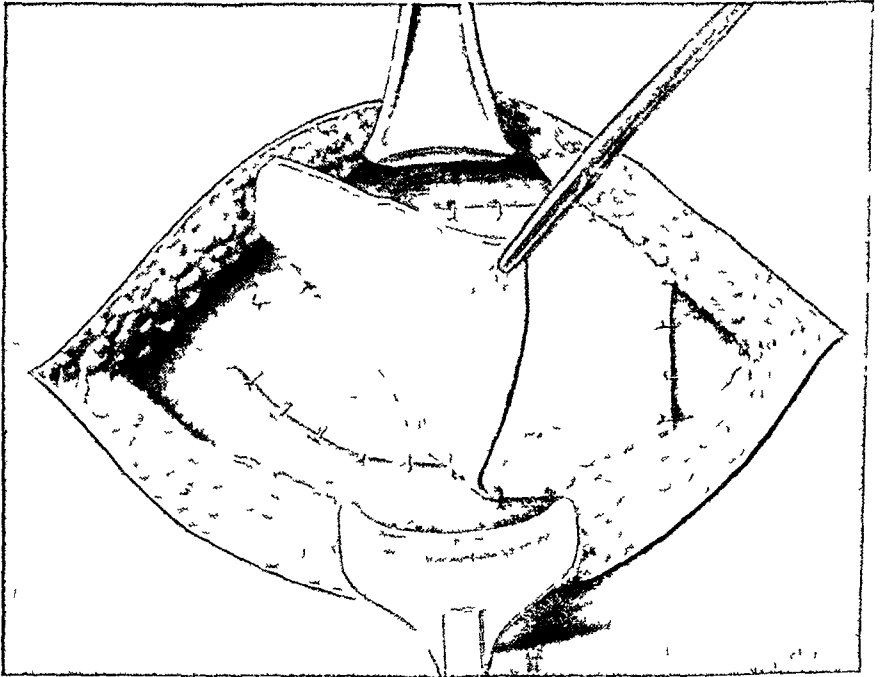


FIG 6—Showing method of reinforcing the Mayo ventral hernia operation by fascia lata graft

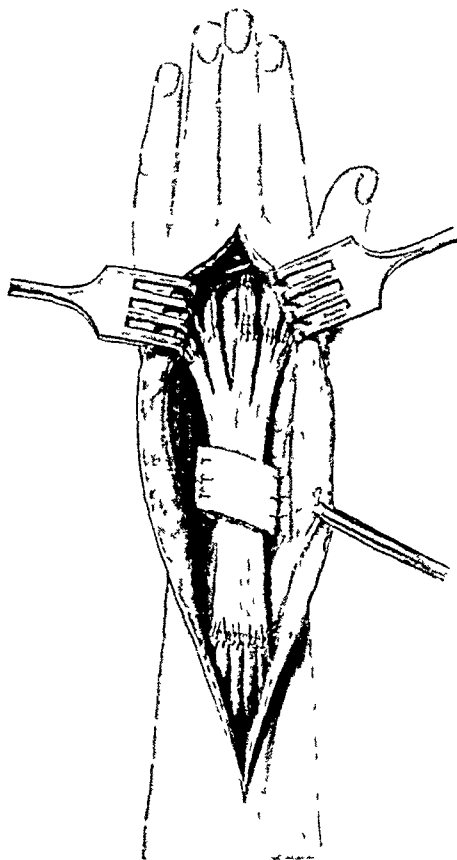


FIG 7—Restoration of extensor tendons of forearm using fascia lata Annular ligament for same made by fascia lata and fat

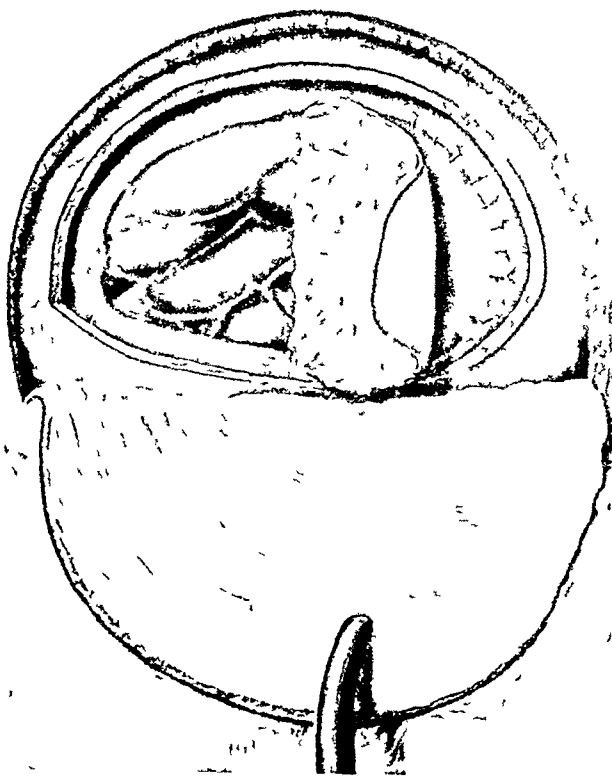


FIG 8—Restoration of dural defect by graft of fascia lata and fat

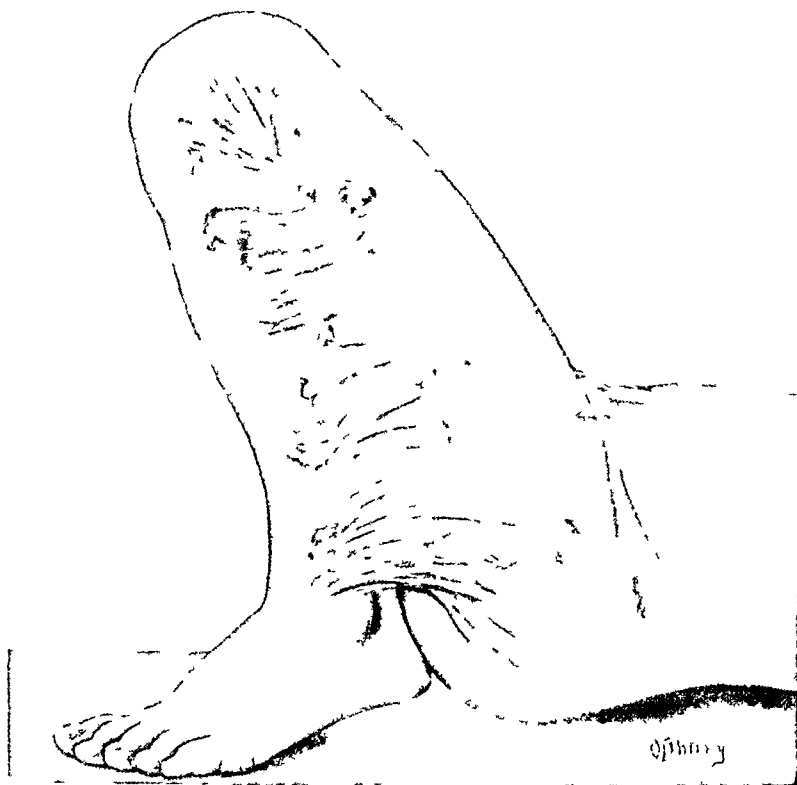


FIG 9 —Great scar from burn binding leg and thigh together



FIG 10 —Scar released by Z plastic, taut nerves in popliteal space covered by fatflaps



FIG 11 —Showing boy after plastic and graft of his leg





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tremendously thickened and replaced entirely by scar tissue, so a free periosteal graft taken from the anterior and mesial surface of the tibia was stitched in place—this operation was done too recently to determine whether, as we are led to expect from experimentation, the transplantation of adult periosteum will limit osteoblastic proliferation

What has been noted of fascia is applicable as well to tendon transplants. The use of one tendon transplanted and trained to do the work of another is well known. Fascia is fully as useful as tendon, but, should a section of a tendon be desired, the palmaris longus is easily available for the purpose.

Free fat is readily transplanted and is especially useful in restoring contours in the face, breast and eye sockets. We have mentioned its use together with fascia in replacing the dura, tendon sheaths, etc. From Garie's clinic come reports of its successful use in filling cavities in osteomyelitic bones, even in the presence of mild infection. We have tucked it under scars which have been bound down, and thus prevented readhesion.

One use in our hands was especially gratifying, viz. After a burn of a child's lower limb, the scar contraction bound the leg to the thigh from the heel in contact with the buttock to the popliteal space. After a Z-plastic procedure on this vast scar, the leg was only released about 30 degrees and a large lozenge-shaped defect behind the knee could not be covered with skin. After the free dissection of the popliteal space it was found the leg could not be straightened because of the contracted, taut trunks of the internal popliteal and perineal nerves, stretching exposed and alone across the angle made by the leg and thigh, like the strings of a bass viol. Further stretching would have ruptured the axons of these taut, bare nerves. To cover them, two oval pedicled flaps of fat were dissected up from adjacent tissues, swung on their pedicles and stitched around each of the exposed nerve trunks. The limb was then vertically suspended by the foot, leaving the bare nerve and fat bands exposed to the dressings. Not only did the fat flaps live but granulated and covered in without skin grafting, a gradual stretching of the nerves permitted the leg to straighten until to-day it is normal.

A study of the various methods of skin grafting has little new to offer save that two camps have formed, one affirming that homografts do not retain their entity as such, the other believing that nearly 50 per cent of homografts survive. Whichever theory is correct, this fact remains, that success from homotransplantation of skin by all of the methods is general, and from the clinical stand-point of results obtained does not differ from those observed in the use of the autograft.

Monks called our attention to the transplantation of whole skin with its nutrient temporal artery alone serving as a pedicle the flap is swung from the temporal region to the face One important consideration of whole skin transplantation has not been sufficiently emphasized, viz the need of scarification of the epidermis of the graft to permit of lymphatic drainage until such time as new blood-vessels and lymph channels are formed

In the field of blood-vessel plastic work, Matas has reported occlusions, partial and complete, of arteries by transplantation of a spiral segment of an arterial wall wrapped around the vessel He has used fascial bands with like results (Carrell's brilliant work in blood-vessel transplantation is common knowledge and needs no discussion, save to emphasize that the segment ultimately becomes a connective-tissue tube whether the muscle survives is still debated ) A segment of vein has been used to replace the urethra but with indifferent success, better results were obtained in its use as a drain for the ventricles in hydrocephalus

The free transplantation of the mucous membrane is extremely limited in its application and aside from its occasional use in the mouth or the conjunctival sac, it is rarely used

Lexer reports brilliant results from the utilization of the patient's own appendix to remedy the congenital absence of, or the loss of, his urethra He used the mucous lining only, stripping it free of muscle and serosa, this gave a patent and useful urethra Until this healed in, he maintained a bladder fistula to keep his field clean

The resected cæcum with its attached appendix, used as a bladder and a urethra in exstrophy of the bladder, has been clinically successful Here the ureters or the base of the bladder with the ureteral orifices are implanted into the cæcal wall and the cæcum and appendix with their nourishing blood-vessels are transplanted bodily to the pelvis

Stewart and others have in like manner successfully utilized a segment of the small bowel to make a new vagina

Transplantation of glandular organs with elaborate anastomosis of arteries and veins is not successful, for, while vascularization is feasible, innervation is not, and the complex tissues do not survive

The early optimistic reports of experimental success in the grafting of the ductless glands led the profession to expect that such procedures would be of clinical value, the test of time, however, has proven them to be practically useless There is still a difference of opinion existing as to the feasibility of both auto- and homotransplants of parathyroids in parathyroprivia, the belief prevails, however, that for some time,

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or at least until the transplants are absorbed, the internal secretion of these parathyroids is sufficient to avert tetany, especially if reenforced by the exhibition of calcium lactate

Homografts of thyroid glands are not successful, they are always absorbed. Autografts, however, have been reported which were feebly functioning after two years.

While these results are interesting as surgical experiments, they have little value from a clinical stand-point, save in the rare instances of accidental total removal of the parathyroids or thyroid, and here greater relief is obtained, in the case of the thyroid at least, by organo-therapy.

Tuffier's work in ovarian transplantation has proven that the homografts are failures, he asserts as well that reimplantation of ovaries after total hysterectomy is useless, however, his results in reimplantations where the uterus was not removed were brilliant, for the patients menstruated, more or less regularly, and were spared the discomforts of the artificial menopause.

The greatest problem of the future is the prevention of immunity or the antagonism of the fluids of one body to the tissues of another.

If our present-day views of the question of autografts are a criterion of the past, the future holds possibilities which "bulk big" with the probability of successfully transplanting tissues, glands or organs, which up to date have defied the skill of the greatest of technicians.

# FRACTURES OF THE FEMUR

WITH END RESULTS IN 62 CASES

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THE poor functional and anatomical results in fractures of the long bones of the extremities led the American Surgical Association and the British Medical Association to investigate the causes for such results. A waning interest in fractures has been renewed, and with the form-blanks covering all the important facts to be obtained concerning fractures, more uniform, complete and exact data are being gathered.

Much has been written concerning fractures of all bones but the femur presents some of the greatest difficulties to be encountered, while its anatomical and physiological importance accentuates the necessity for a good result.

In considering fractures of the femur it is well to take them up in different groups according to the portion of the bone fractured, such as those of the upper end (neck and through the trochanters), the shaft and the lower end. The varieties, manner of production and treatment of fractures have been so thoroughly dealt with in the special fracture number of the *American Journal of Surgery* for March, 1915, by such authorities as A. Lane, W. L. Estes, A. P. C. Ashhurst, F. H. Albee, J. B. Walker and others, that they will not be considered in this paper except as they concern reported cases.

With the more general use of the Röntgen rays we are enabled to see the exact position of the fragments before and after treatment, so we can follow cases to observe how kind nature is in producing generous callus to cover our defective reductions, with resultant solid union (Figs 1, 2, 3, 4, 5, 6 and 7). The anatomical relation of the fragments may be bad and still give a good functional result (Table IV).

The basis of this article consists of the fractured femurs from Dr. Charles H. Frazier's service at the Episcopal Hospital during the 10 years from 1905 to 1915, and I am indebted to him for the privilege of reporting the cases.

Of the 109 cases on record we were able to follow 62 (57 per cent), 15 fractured through the neck, 6 through the trochanters, 36 of the shaft, and 5 of the lower end. A number of the cases have been previously reported more in detail before this Academy and elsewhere.

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\* Read before the Philadelphia Academy of Surgery, May 3, 1915.

## FRACTURES OF THE FEMUR

by Dr A P C Ashhurst<sup>1</sup> Of the 47 fractures not followed there were 4 each through the trochanters and of the lower end, 15 of the neck and 24 of the shaft, the condition of the patients at the time of discharge was as follows 10 cured, 24 recovered, 10 improved, 1 at own request, and 2 refused treatment

Considering the fractures of the neck there were 10 females and 5 males, with ages ranging from 14 to 84 years (average  $64\frac{1}{2}$ ) All were simple fractures produced by indirect violence The time in the hospital ranged from 2 to  $29\frac{1}{2}$  weeks (average  $6\frac{2}{3}$ ), while the average time from work of those who survived was  $22\frac{1}{2}$  weeks Of the 8 cases dying in the hospital (5 intracapsular) 6 were females and 2 males, with ages ranging from 65 to 84 years (average  $74\frac{1}{2}$ ) The cause of death was given as 1 each from uræmia, senility and carcinoma of the stomach (autopsy confirmation), 2 from pneumonia, while in 3 it was not stated A peculiar fact is noted in that 6 of these occurred during the services of 1905 and 1906, but no definite explanation for this was found The functional and anatomical results are given in Table I

There were 6 cases of simple fracture through the trochanters (Table II), all being of the male sex and treated non-operatively Three were caused by direct and 3 by indirect violence The number of weeks in the hospital averaged 7 with extremes from 4 to 10, while the time from work averaged 34 weeks, varying from 12 to 93 The earning power was less in 4 cases, each having a moderate anatomical result with moderate to bad functional result, while the 2 with the same earning capacity had both good anatomical and functional results

Of the 5 cases where fracture occurred at the lower end of the femur, again they were all of the simple type produced by direct violence, all males with ages ranging from 6 to 61 years (average 34) One case with bad position of the fragments was plated with resultant good apposition but only moderate return of function Here the time in the hospital varied from 2 to 11 weeks (average  $5\frac{1}{2}$ ), the patient going out in 2 weeks had the limb in a plaster cast returning later for the removal of the cast The earning capacity in these cases was the same in 2 and less in 2, the fifth developed delirium tremens and died after 3 weeks Functional and anatomical results are shown in Table III

Over half the cases followed were fractures of the shaft, 33 males and 3 females with ages from 3 to 74 years (average  $23\frac{1}{3}$ ) Five of the cases were plated because of the inability to obtain proper re-

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<sup>1</sup> Ashhurst, A P C Fractures Through the Trochanters of the Femur ANNALS OF SURGERY, Philadelphia, 1913, October, p 495, also, The Prevention and Treatment of the Disabilities Following Fractures of the Limbs American Journal of Surgery, 1915, XXIX, 114

duction, 3 good and 2 moderate anatomical results followed, and 4 good and 1 moderate functional result. The time in the hospital ranged from 1 day to 59 weeks (average 10 weeks). One case died of shock the day of admission, while another died on the third day of a fractured skull. The disability period was between 8 and 115 weeks (average 16.9), giving 29 good, 4 moderate, and 2 bad functional results from 25 good, 6 moderate and 4 bad anatomical results. The case who stayed in the hospital 59 weeks and was out of work 115, developed delirium tremens, got the leg in bad condition, causing sloughing of tissue, when a cast was applied, with both bad anatomical and functional results. Thirty cases were of the simple type, while Cases 3, 9, 19, 26, and 27 were comminuted, and Case 11 compound, the fracture having been produced by indirect violence (see Figs 2 to 7). Twenty-four fractures resulted from direct and 12 from indirect violence.

Tables V, VI, VII, VIII, and IX have been compiled so that the various summaries of results, such as age groups, disability periods, etc., of the different classes of fractures may be noted at a glance.

As to treatment the non-operative gave as good results, functionally, as the operative, although the plated cases were selected, which without operation most certainly would have given poor results. Anatomical results were based on roentgenograms when they were employed and in the other cases on the amount of shortening or deformity. The latter is faulty in that good approximation and alignment of the fragments is not necessary for a straight and unshortened limb. The skiagraph is the only accurate basis for our conclusions, but unfortunately not all had roentgenograms after completed treatment.

The mortality of 11 cases was not due directly to the fracture of the femur excepting in the one dying from shock, while in a number of the others it was a contributing factor.

In conclusion from the facts gathered

- 1 Fractures of the neck were more frequent in the aged of the female sex, indirectly cause a high mortality because of the age of the patient and the lowered resistance, and give a moderate disability period.

- 2 Fractures through the trochanters were all males and gave a long disability period with lowered earning capacity in two-thirds of the cases.

- 3 Fractures of the lower end of the femur gave an average disability of about 6 months while a good functional result was obtained in about one-half of the cases. They were all males.

- 4 Fractures of the shaft gave the best results and had the shortest disability period. They were the most frequent and were mostly males.

- 5 The mortality from fractures of the femur other than of the neck was low, being about 2 per cent in this series.



FIG 1—J F aged fifty years who had broken his left femur shaft thirty years previous to this X-ray He has two and one-half inches shortening, wears a high shoe and makes good wages but says he could make one-third more if not for his disability He has some pain in region of fracture during damp weather Plate shown to illustrate the way nature cares for defects, giving moderate functional result

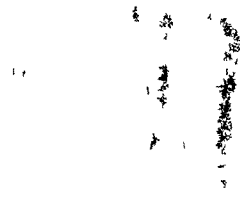


FIG 2—Case 11 of Table IV, under Fractures of the Shaft, which was compound E F girl seven years of age Lateral view before setting under ether Had 3 cm shortening Left femur

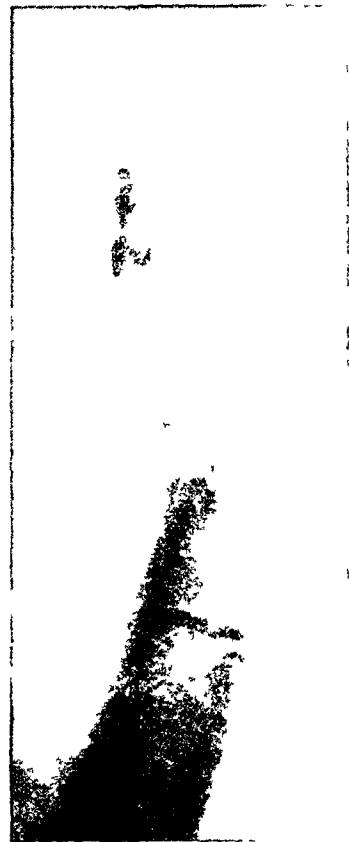


FIG 3—Same case as Fig 2 Anteroposterior view before setting under ether

FIG 4—Same case as Fig 2 Lateral view after setting under ether





FIG 5—Same case as Fig 2 Anteroposterior view after setting



FIG 6—Same case as Fig 2 Lateral view six months after setting

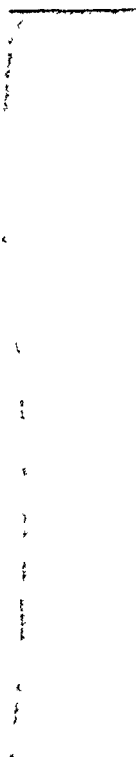


FIG 7—Same case as Fig 2 Anteroposterior view six months after setting

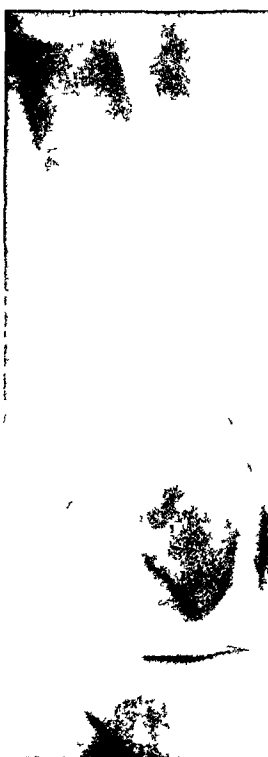


FIG 8—G O N twenty years of age fracture of femoral shaft Lateral view



FIG 9 —Same case as Fig 8  
Anteroposterior view



FIG 11 —F R twenty-  
six years of age Fracture  
of femur

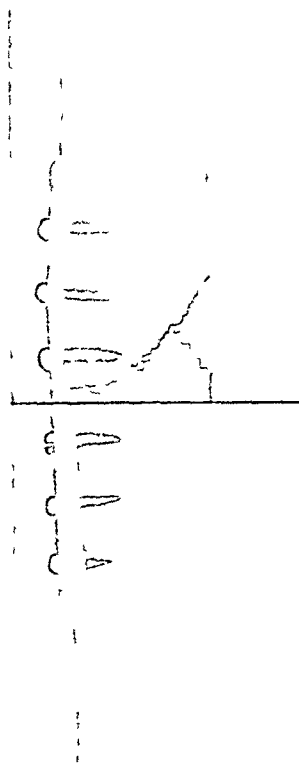


FIG 12 —F R Same as  
Fig 11 six weeks after opera-  
tion (late)

FIG 10 —Same case as Fig 8  
Dr C H Frazier s service Epis-  
copal Hospital Operated by Dr  
A P C Ashhurst November 17,  
1914 with good result X-ray of  
limb four weeks after Lambotte  
plate was applied



# FRACTURES OF THE FEMUR

TABLE I  
FRACTURES OF NECK OF FEMUR

No	Sex	Age	Treatment		X-ray		Weeks in hospital	Weeks from work	Gaining power	Functional result			Anatomical result			Died
			Operative	Non-operative	Early	Late				Good	Mod	Bad	Good	Mod	Bad	
1	M	14		C	*	*	6	10	Same	*			*		*	Pneumonia
2	M	30		†	*		4	30	Less							
3	F	58		†		*	29½	Idle	Idle		*		*	*		
4	F	60		E and L			6	24	Same	*			*	*		Pneumonia
5	M	63		E			11	Idle	Idle	*			*	*		
6	M	65		†		*	2½		Same							
7	F	67		†			6½		Same	*			*			Pneumonia
8	F	70		E	*		17	26					*			
9	F	70		†	*		2									
10	F	74		C	*		2½									Cause not stated Cause not stated Senility
11	F	75		E and C			3	Idle	Idle		*			*		
12	F	76		†			4									
13	F	77		†			6									Cause not stated Cause not stated Pneumonia
14	M	82		†			2									
15	F	84		†			2									
Total	M F	Ave 64½					Ave 6½	Ave 22½	Same 3 Less 1 Idle 3	4	2	1	3	3	1	8

Note—Case 3 died 3 years later Case 5 died 5½ years later  
Key to tables

Mod=Moderate  
E=Buck's extension  
L=Lateral extension  
VE=Vertical extension  
C=Plaster-of-Paris cast  
H=Hamilton splint

S=Splint  
Splint=Cocreation splint  
SB=Sand bags  
†=Iy pe not stated  
Idle=Not working, being too old or for other cause  
\*=Time X-rays were taken and end result in each case

TABLE II  
FRACTURES THROUGH TROCHANTERS

No	Sex	Age	Treatment		X-ray		Weeks in hospital	Weeks from work	Earning power	Functional result			Anatomical result			Died
			Operative	Non-operative	Early	Late				Good	Mod	Bad	Good	Mod	Bad	
1	M	42		S and C	*		8	27½	Less	*	*		*	*		
2	M	45		E	*		6½	12	Same				*			
3	M	48		E	*		4	48	Less	*	*		*	*		
4	M	54		E	*		4½	9½	Same	*			*			
5	M	54		E and S	*		10	93	Less			*	*	*		
6	M	70		†	*		8	over	Less							
								14½								
Total	6	Ave 52	0	6	6	0	Ave 7	Ave 34	Same 2 Less 4	2	2	2	2	4	0	

TABLE III  
FRACTURES OF LOWER END OF FEMUR

No	Sex	Age	Treatment		X-ray		Weeks in hospital	Weeks from work	Earning power	Functional result			Anatomical result			Died
			Operative	Non-operative	Early	Late				Good	Mod	Bad	Good	Mod	Bad	
1	M	6		C	*		4	4	Same	*			*			
2	M	30		E and C	*		7½	28	Same	*			*			
3	M	35		E and C	*		11	34	Same		*	*	*	*		
4	M	38		E and C	*		2	28	Less							
5	M	61		†			3		Less							
Total	5	Ave 34	1	4	3	0	Ave 5½	Ave 23½	Same 2 Less 2	2	1	1	3	1	0	I

Delirium tremens

TABLE IV  
FRACTURES OF SHAFT OF FEMUR

No	Sex	Age	Treatment		X-ray		Weeks in hospital	Weeks from work	Earning power	Functional result			Anatomical result			Died
			Operative	Non-operative	Early	Late				Good	Mod	Bad	Good	Mod	Bad	
1	F	3		E VE	*		7	13	Same	*			*			Died
2	M	3		H and E	*		8	8	Same	*			*			
3	M	3		E and C	*		9	12	Same	*			*			
4	M	4		E and C	*		6	9	Same	*			*			
5	M	4		E	*	*	9½	11	Same	*			*			
6	M	5		H and E	*	*	8	17	Same	*			*			
7	M	5		H and E	*	*	12	8	Same	*			*			
8	M	6		H and E	*		6	9	Same	*			*			
9	M	6		C	*		7	10	Same	*			*			
10	M	6		E and C	*	*	8	11½	Same	*			*		*	
11	F	7		H and E	*		11½	13	Same	*			*			Shock
12	M	7		E and SB	*		8½	9	Same	*			*			
13	M	8		E	*		6	14	Same	*			*			
14	M	10	Plate	E and C	*	*	6½	12	Same	*	*		*	*		
15	M	11			*		11	14	Same	*			*			
16	M	13	Plate	E and C	*		7	19	Same	*			*			
17	M	13			*		15	30	Same	*			*			
18	M	14	Plate	E	*	*	12½	20	Same	*			*			
19	M	15			*	*	12	17	Same	*			*			
20	M	16	Plate	Splint	*	*	13	17	Same	*			*			
21	M	18		Splint	*	*	13	17	Same	*			*			Fractured skull
22	M	18		Splint	*	*	1 day	21	Same	*			*			
23	M	21	Plate	E and C	*	*	7½	26	Same	*	*		*	*		
24	M	23			*		10	24	Same	*			*			
25	M	34	Plate	E and C	*	*	8	20	Same	*			*			
26	M	34			*	*	9	115	Less	*			*			
27	M	38		Splint	*	*	3 days	12	Same	*			*			
28	M	45		E and C	*	*	6	9½	Same	*			*			
29	M	47		†	*	*	7	21	Same	*			*			
30	M	50		†	*	*	6½	26	Less	*	*		*	*		
31	M	50		E and SB	*	*	7	21	Same	*			*			Fractured skull
32	M	50		HE and C	*	*	15	Idle	Same	*			*			
33	M	52		E	*	*	14	Idle	Same	*			*			
34	M	53		E and C	*	*	14	Idle	Same	*			*			
35	M	73		†	*	*	7	Idle	Same	*			*			
36	F	74		†	*	*	7	Idle	Same	*			*			2
Total	M 33 F 3	Ave 23½	5	31	24	17	Ave 10	Ave 169	Same 31 Less 3	28	4	2	24	6	4	

TABLE V  
FRACTURE OF FEMUR  
FRACTURE LEVEL ACCORDING TO AGE WITH AVERAGE DISABILITY IN WEEKS

	Total	Under 15 years			15 to 45			45 to 60			60 and over		
		Non-operative	Operative	Average disability	Non-operative	Operative	Average disability	Non-operative	Operative	Average disability	Non-operative	Operative	Average disability
Neck	15	1		10	1		30			17	12		25
Trochanters	6				1		27			3	1		14
Upper	5	2			2	1	5	4					5
Middle	28	13	2		4	1		7			1		
Shaft, lower	1										1		
?	2	1				1							
Total	(36)	(16)	(2)	11	(6)	(3)	21	(7)		34	(2)		Over 52
Lower end	5	1		4	2	1	22			1			*
Sum totals	62	18	2		10	4		11	0		15	0	

\* The 11 cases which died early are not considered in Average Disability  
? Region of shaft not stated

# FRACTURES OF THE FEMUR

## TABLE VI

### FRACTURE OF FEMUR

DISABILITY PERIOD ACCORDING TO ANATOMICAL RESULT AND AGE

	Total	Anatomical result				Under 15 years	15-45	45-60	Over 60
		Good	Moderate	Bad	Died				
Under 6 weeks	11	1			10	1	1	1	8
6 to 12 weeks	16	16				12		4	
3 to 6 months	19	11	5	2	1	7	7	2	3
6 to 9 months	8	4	3	1			6	1	1
9 to 12 months	1		1					1	
Over 12 months	4	1	2	1				2	2
Not stated	3		3					1	2
Total	62	33	14	4	11	20	14	12	16

## TABLE VII

### FRACTURE OF FEMUR

FUNCTIONAL AND ANATOMICAL RESULTS ACCORDING TO AGE (NON-OPERATIVE AND OPERATIVE)

	Total	Under 15		15 to 45		45 to 60		60 and over	
		Non-operative	Operative	Non-operative	Operative	Non-operative	Operative	Non-operative	Operative
Functional									
Good	36	18	1	5	3	5		4	
Moderate	9		1	2	1	3		2	
Bad	6			2		3		1	
Death	11			1		1		9	
Anatomical									
Good	33	17	2	5	2	4		3	
Moderate	14	1		2	2	5		4	
Bad	4			2		2			

## TABLE VIII

### FRACTURE OF FEMUR

FUNCTIONAL RESULTS ACCORDING TO ANATOMICAL RESULTS

	Total	Functional		
		Good	Moderate	Bad
Anatomical				
Good	33	30	3	
Moderate	14	5	6	3
Bad	4	1		3
Total	51	36	9	6



TABLE IX  
FRACTURE OF FEMUR  
SUMMARY TABLE

Location	Number	Sex		Age in years			Treat- ment		Time in hospital in weeks				Weeks absent from work				Earning capac- ity		Functional result			Anatomical result			Died
		Male	Female	Average	Old	Young	Operative	Non oper- ative	Total	Average	Long	Short	Total	Average	Long	Short	Same	Less	Good	Moderate	Bad	Good	Moderate	Bad	
Neck	15	4	11	64½	84	14	0	15	100	6¾	29½	2	90	22½	30	10	7	8	4	2	1	3	3	1	8
Trochanter	6	6	0	52	88	46	0	6	41	7	10	4	204	34	91	9½	2	4	2	2	2	2	0	0	
Shaft	36	33	3	23½	74	3	5	31	362	10	59	¾	571	16½	115	8	31	5	29	4	1	25	6	4	
Lower extremity	5	5	0	34	61	6	1	4	27½	5½	11	2	94	23½	34	4	2	2	2	1	1	3	1	1	
Totals	62	48	14	37	88	3	6	56	530	9	59	¼	959	20	115	4	42	19	37	9	5	33	14	5	

NOTE

Neck  
Trochanters  
Shaft  
Lower end

Under 15 years    Over 15 years  
1    14  
0    6  
19    17  
1    4

Shaft

Lower end

Result of Operated Cases

4 good and 1 moderate functional  
4 good and 1 anatomical moderate  
1 good anatomical and moderate functional

# END RESULTS IN FRACTURES OF BOTH BONES OF THE LEG \*

BY RUTHERFORD L JOHN, M D  
OF PHILADELPHIA, PA

IN presuming to bring forward the subject of fractures of both bones of the leg, this paper has no intention of discussing the question of treatment. It will limit itself to a statement of the end results in a series of 40 cases, that being the number I was able to follow up of 288 cases treated in the Episcopal Hospital between the years 1905 and 1915.

Of the forty cases followed, 6 were compound and 34 not compound fractures, *i e*, they were either simple or comminuted.

Group I classes cases as to age, sex, and leg involved, as follows

Years	No cases	Male	Female	Right	Left
0-14	7	6	1	3	3
15-44	22	13	9	13	8
45-59	9	7	2	5	4
60-	2	0	2	2	0
	—	—	—	Two cases unnoted	
Total	40	26	14	23	15

As can be seen from the table, by far the greater number of cases occurred between the ages of 15 and 44 years, 22 out of 40, or 55 per cent. Males were involved in 65 per cent, and 57.5 per cent of the fractures occurred in the right leg.

Group II gives us one of the most interesting classifications of the series. Here I have endeavored to show the effect of the anatomical result on the period of disability. The period of disability has been taken to mean the number of weeks the patient was kept from his work. The measurements were made from the lower border of the patella to the internal malleolus.

## GROUP II A (ALL CASES)

Anatomical result	Amt of shortening	No cases	Aver period disability
Good	0-0.99 cm	17	14.8
Moderate	1.0-1.99 cm	16	21.7
Bad	2.0- cm	6	45.3

The above group includes all cases. The following table gives the same data for cases not compound.

---

\* Read by invitation before the Philadelphia Academy of Surgery, May 3, 1915.

# RUTHERFORD L JOHN

## GROUP II B (CASES NOT COMPOUND)

Anatomical result	Amt of shortening	No cases	Aver period disability
Good	0-0.99 cm	15	14.5
Moderate	1.0-1.99 cm	14	20.1
Bad	2.0- cm	4	42.0

While in the above tables, a shortening of from 1.0 to 1.99 cm is classed as a moderate *anatomical* result, yet in practically all of these cases there was a very good *functional* result, the patients being able to do their former work without any loss of endurance or knowledge of the shortening of one leg.

Of all of the cases followed, there had been no open operative treatment in any of the simple or comminuted fractures. Two cases of comminuted fractures (X-ray photographs, Figs 1, 2, 3 and 4) were treated by the Steinmann nail traction. Both of these cases healed with no shortening. The average period of disability for these two cases was 12.5 weeks, as compared with the average period of 15 weeks for the other 15 cases in the same group. Both cases were badly comminuted and, aside from the more rapid recovery and the perfect anatomical result, the Steinmann nail traction allowed these patients, while under constant traction, to move about a bit in bed, a fact which gave them considerable comfort and of which they speak with gratitude. That traction by means of the Steinmann nail is not always so satisfactory can be realized from a glance at Fig 5. This case of compound fracture of both bones had a Steinmann nail driven through the os calcis on the sixth day after injury and twenty-two pounds of weight applied for twelve days, with no apparent reduction of the deformity. The bones were then exposed and the tibia plated, with an ultimately good anatomical and functional result (see Fig 6).

The six compound cases of the series are grouped in the following table to show age periods and operative treatment.

## GROUP III

Years	No cases	No oper	Immed oper	Delayed oper (after 10 days)
0-14	2	1	1	
15-44	4			4
45-59	0			
60-	0			

Group IV shows the compound cases grouped as to amount of shortening and average period of disability.



FIG 1—Comminuted fracture of tibia and fibula before treatment by Steinmann nail traction See Fig 2

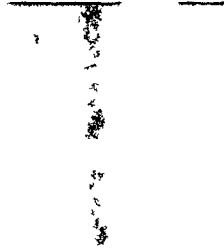


FIG 2—Comminuted fracture of tibia and fibula treated by Steinmann nail traction (sixteen pounds) Five months after injury, no shortening

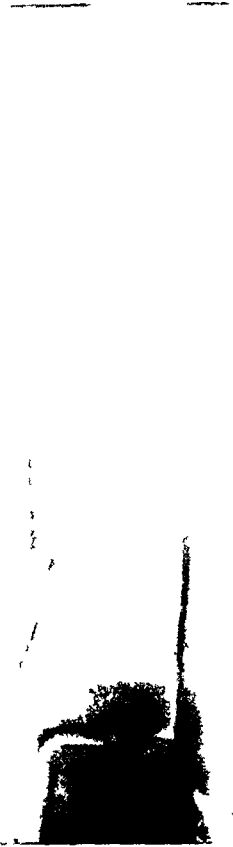


FIG 3—Comminuted fracture of tibia and fibula before treatment by Steinmann nail traction See Fig 4

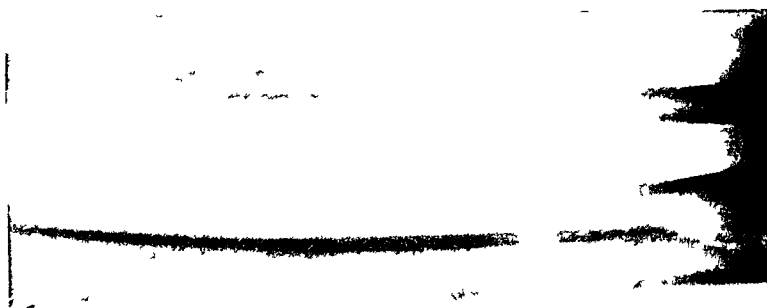


FIG 1 —Comminuted fracture of tibia and fibula, treated by Steinmann nail traction. Twenty days after injury, no shortening.

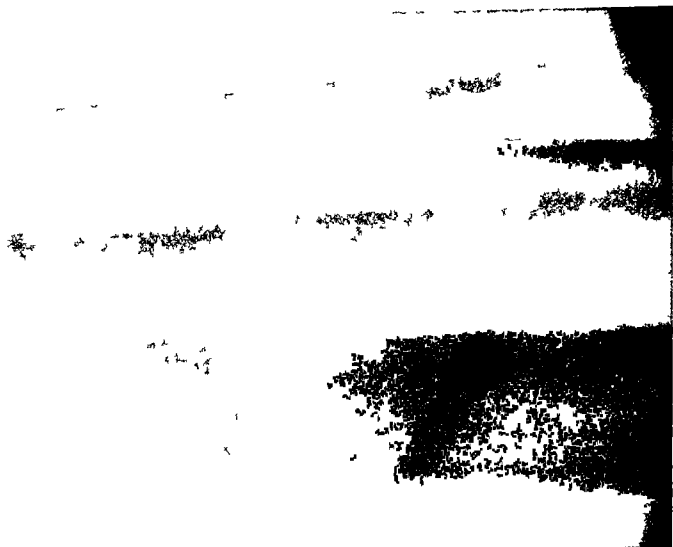


FIG 5 —Compound fracture of tibia and fibula after Steinmann nail traction for twelve days (twenty two pounds). See FIG 6

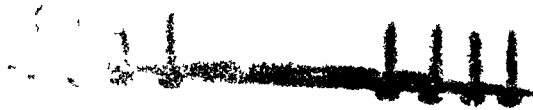


FIG 6 —Compound fracture of tibia and fibula, plated eighteen days after injury. Shortening 1 cm.

## END RESULTS IN FRACTURES OF LEG

### GROUP IV

Amt of shortening	No cases	Aver period of disability
0-0.99 cm	2	16
1.0-1.99 cm	2	24
2.0- cm	2	52

The following table gives the average period of disability in weeks for each region of bone considered, according to age periods

### GROUP V

Years	AVERAGE PERIOD OF DISABILITY		
	Upper $\frac{1}{3}$	Middle $\frac{1}{3}$	Lower $\frac{1}{3}$
0-14	11.5 (2)	15 (2)	15 (3)
15-44	0	16 (2)	23+ (19)
45-59	0	86 (2)	21.4 (8)
60-	0	0	9 (2)

The figures in parentheses represent the number of cases in each region. While Pott's fractures are not included in the series, it will be noted that the great majority of cases occurred in the lower third of the leg.

The conclusions to be drawn from these tables point to neither a strictly conservative nor a radical operative treatment as giving the best ultimate results. As so often stated, the majority of fractures occurred in males, between 15 and 40 years of age.

1 The right leg was affected in 57.5 per cent of cases.

2 The average period of disability is directly dependent upon the anatomical result.

3 A moderate anatomical result may mean a perfect functional result.

4 Traction by means of the Steinmann nail would seem to be a hopeful compromise between a conservative and an operative treatment of obstinate cases.

5 The lower third of the bone is the most often involved but this fact has no apparent relation to age or period of disability.

6 The average time for reduction was on the day of injury except in four cases of compound fractures.

# TRANSACTIONS OF THE NEW YORK SURGICAL SOCIETY

*Stated Meeting, held May 12, 1915*

The President, DR. FREDERIC KAMMERER, in the Chair

## RECURRING APPENDICEAL FISTULA

DR. GEORGE WOOLSEY presented a patient, a woman, fifty-three years of age, who had been operated upon eighteen years ago for appendicitis, the appendix being supposedly removed. After that, she was well until four years ago, when she began to suffer from severe pain over the appendix region, which became swollen and tender. She was operated upon at the Hudson Street Hospital for pericæcal abscess, and the wound healed after some time. Two years ago pain and tenderness appeared over the scar and she suffered from distention and nausea, but had no vomiting. The bowels were constipated, but had been regular since the first operation. Dr. Woolsey operated upon her at the Presbyterian Hospital on May 7, 1912, going through the appendix scar and encircling the fistula. The cavity was found to contain pale green gelatinous material, also some soft white material with dirty streaks, and yellow mucopurulent material, which had a decided fecal odor. It presented somewhat the appearance seen in some ovarian cysts. An abdominal incision was made, and the pelvic viscera were explored and found to be normal. The patient left the hospital with a small sinus, two weeks after her admission. In March of 1913, she was admitted to Bellevue Hospital with a swelling in the region of the cicatrix, and with a fistula discharging whitish pus and other material thought to be fecal. The odor of the discharge was fecal. The patient thought there was flatus coming through the fistula at times. An X-ray was taken and showed no intestinal fistula, but only a rather high cæcum. She was again operated upon on April 6, the incision going through the old scar. The cæcum was found to be adherent to the abdominal wall, and was dissected free. A probe was passed into the fistulous tract for two inches and was then arrested. It was thought that a fecal fistula would be found, but instead of this two inches of the distal end of a large appendix was found, which had not been

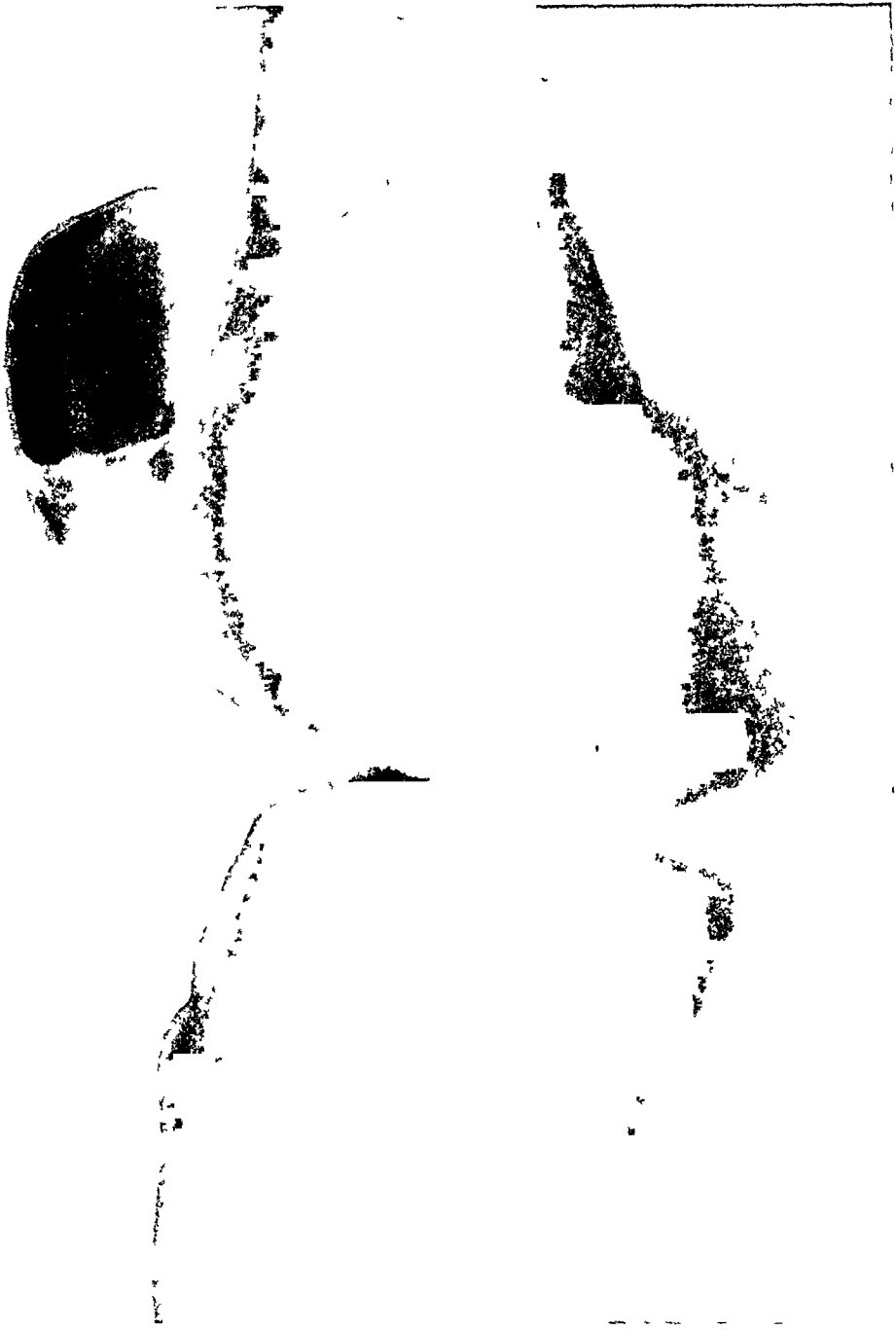


FIG. 1 —Fracture of patella from direct violence bony union





## FRACTURE OF PATELLA

removed. There were no other abnormalities, and the wound was closed. There is now no opening at all.

DR ARTHUR S. VOSBURGH cited a case where the recurring fistula, unlike Dr. Woolsey's case, could not be ascribed to the persistence of the mucous membrane. The man in question had been operated for a diverticulitis. The abscess had been drained, the diseased portion of the bowel had not been excised. The tract leading to the bowel would not remain permanently healed. The patient had a constantly recurring fistula, discharging sometimes a little pus and at others a little fecal matter. A probe could be passed along the tract four or five inches and there its end seemed to enter a free cavity. Dr. Vosburgh operated, and deep within the abdomen, lying in the portion of the tract communicating with the sigmoid, found a small piece of rubber tissue. It was certain that the patch had not come from any of the gloves used at the operation. It had evidently been left in the tract at some previous time, not necessarily at the first operation, but possibly at some dressing, and that accounted for the non-closure of the fecal fistula seated deep in the belly.

DR PARKER SYMS said that he had seen a case somewhat similar to that presented by Dr. Woolsey. He had operated on a man for an acute perforated appendix, with a large abscess. The appendix was not removed. Some months later, the man had trouble again. An abscess formed, which opened spontaneously and a fistulous tract resulted. In operating for the purpose of closing this fistulous tract, it was found that it consisted of the appendix. The appendix was almost in contact with the skin. The appendix was removed and the patient was cured.

### FRACTURE OF PATELLA BONY UNION WITHOUT TREATMENT

DR SYMS presented a patient, O. S., twenty-eight years of age, who had been admitted to Lebanon Hospital on November 29, 1914, with a dislocated external semilunar cartilage. A month before admission the patient had been thrown from the seat of a wagon, and struck his knee on the curbstone with the leg in a flexed position. At that time, he reported to the out-patient department, but the doctor who saw him failed to recognize the condition and allowed him to go home, telling him to keep his leg quiet on account of the swelling and pain, but no fixation apparatus was applied. When he was finally admitted to the hospital in November, a clinical diagnosis of a displaced and movable semilunar cartilage was made. An X-ray picture (Fig. 1) revealed the fact that the patient had had a fracture of the patella, which had united in good position in spite of the fact that no treatment had been employed.

Of course, the patella had been fractured by direct violence. The good result obtained was due to the fact that the quadriceps tendon was not lacerated through at the time of injury, so that the fragments of the patella were not pulled apart, but were held in their normal position by the tendon, and the patient was able to walk because his tendon was essentially intact.

#### RUPTURE OF QUADRICEPS FEMORIS TENDON

DR F. KAMMERER presented a man of sixty-four, who had sustained a rupture of the right quadriceps tendon. The patient was crossing the street, when he slipped and fell to the ground. He had no pain whatever, but was unable to rise and to extend the injured limb at the knee. He was treated at home for two weeks and then came to the hospital. At the time of his admission the joint was distended with fluid. The superior border of the patella could be distinctly felt through the skin and gave the impression of a fracture of that bone, which, however, was disproved by X-ray examination. On dissecting a flap from the anterior wall of the joint it was found that the tendon of the rectus femoris had been torn from the superior border of the patella, and from the entire upper half of its anterior surface to a line passing exactly over the middle of the bone in a transverse direction. The tendon had retracted to a point about half an inch above the superior border of the patella and two fingers could be readily introduced into the knee-joint through this rent. The latter was filled with partly coagulated, partly fluid blood, which was removed. The two lateral ligaments of the knee-joint—the continuations of the vastus externus and internus to the tibia—were intact. The upper edge of the torn tendon was dissected out and brought down to the lower edge, running across the middle of the patella, and united to it by interrupted chromic acid sutures, complete closure of the wound without drainage. This was six weeks ago. The patient can bend his knee almost to a right angle, and also extend it. The speaker said this was the second case of rupture of the quadriceps tendon he had observed, the first coming under his care many years ago and involving the upper end of the tendon of the rectus femoris—the rarer variety. In the case presented to-night there was not a trace of tendon tissue left on the upper anterior half of the patella and the speaker had to content himself with suture of the thin layers of tissue that pass over the anterior surface of the patella to the ligamentum patellæ. Evidently this weak suture had been sufficient to hold the tendon in place until also its posterior surface had become firmly united to the denuded surface of the patella.

## CYST OF THE HUMERUS

DR WILLY MEYER said that two cases of rupture of the quadriceps tendon had come under his care, one of them being bilateral. The first patient was a man eighty years of age who, in getting out of the bathtub, slipped and ruptured the quadriceps tendon on both sides, but not so severely injuring the capsular arrangement of the knee-joint as in the case presented by Dr Kammerer. In view of his age, he was opposed to operative treatment. The extremities were simply placed in splints, after bringing the parts in the best apposition possible with adhesive plaster, figure-of-eight. Centrifugal massage of the muscles was then instituted, so as to always bring the parts downward to the patella. The rupture had happened about half an inch from the upper end of the patella. The man made a good recovery, and later used his limbs perfectly for several years.

In the case of the other patient, the joint was opened, and revealed a far-reaching rupture. The ligamentous apparatus was carefully stitched up and the tendon brought down to the patella and sutured with a couple of sutures. The patient recovered with good function of the leg.

## CYST OF THE HUMERUS

DR FRANK S. MATHEWS presented a boy, thirteen years of age, who was admitted to St. Luke's Hospital in January with a fracture of the lower portion of the humerus. The boy had had a very slight trauma, having fallen while walking on the sidewalk. It was learned, however, that he had had pain in the limb all winter. X-ray revealed the cyst and fracture. An incision was made, and on reaching the bone the cortex was found to be as thin as paper. The cyst contained an old blood clot, but in the lower portion there was solid tissue which was reported by the pathologist to be osteitis fibrosa. A bone splint was inserted and fairly firm union had resulted.

Several pictures were presented, in some of which an amount of new bone could be seen. The most interesting picture showed the bone splint surrounded by new bone.

Dr Mathews said that the bone splint would probably be absorbed. This was the first case of the kind he had ever operated on. The bone splint was inserted because it was feared that there might be considerable shortening. The splint was taken from the anterior border of the tibia, and included the periosteum.

DR F. KAMMERER recalled a case, which he had shown to the Society many years ago, of fibrosis of the femur in a man in middle life. The latter had sustained a spontaneous fracture of the thigh in its lower third two years before he came under the speaker's care, which

apparently was firmly united when he was admitted to the hospital with a second spontaneous fracture in the upper third of the same femur. When the medullary cavity of the shaft was opened at the site of this fracture a large amount of fibrous tissue, completely filling it, was removed. After a stormy convalescence the second fracture also became firmly united, but considerable deformity of the limb resulted. The patient when last seen, some years ago, had not again fractured the bone.

#### TRAUMATIC EPILEPSY IMPLANTATION OF FASCIA AND FAT GRAFT INTO DURAL DEFECT

DR JOHN DOUGLAS presented a patient, a young negro man, twenty-six years of age, who had been struck with a hatchet on the left side of the head on January 6, 1913, causing a compound depressed fracture of the skull in the left parietal region. Following the blow, he remained unconscious for one hour and on regaining consciousness found that his right arm and the right side of his face were paralyzed. He was operated on for elevation of the depression nine days later, and his paralysis gradually disappeared about two weeks after the injury.

Seven months later, in August, 1913, he had an attack of twitching in the right side of his face and right arm. The next attack was in February, 1914, when he also became unconscious. Subsequently, up to his admission to St. Luke's Hospital in September, 1914, he had similar attacks about once a month, seven in all. Examination showed a depressed scar in the right parietal region, over the motor area of the arm and face.

An osteoplastic flap was turned down, revealing an area of deficient bone along the line of fracture, with the dura replaced by scar tissue, which was adherent to the cortex. A small fragment of bone was seen sticking through the dura into the cortex. This was removed, as it was believed to be the cause of the twitching and convulsions. The exposed cortex was covered with silver foil and the flap was replaced. The wound healed readily, and the patient left the hospital in a little over two weeks.

Shortly after leaving the hospital, he again began to have convulsions, more severe and oftener than before. He returned to the hospital, and a second operation was performed, turning down the same osteoplastic flap. The old scar tissue along the line of fracture was found to be adherent to the cortex, the silver foil had become rolled up, and an area of dura  $1\frac{1}{2}$  by 3 cm. was replaced by dense connective tissue, showing that the idea that the convulsions were due to the small

piece of bone was probably wrong and that they were more likely caused by the adhesions of the cortex to the wound area. A piece of fascia lata was removed from the leg, about  $2\frac{1}{2}$  by 4 cm in size, with  $\frac{1}{2}$  cm of fat attached to the outer surface. All the scar tissue was stripped from the cortex until healthy dura was exposed at the edges, and the fascia lata graft was applied with the fat surface in contact with the cortex and the edges sutured with fine catgut to the healthy dura. The osteoplastic flap was then turned back. The wound healed by primary union. That was on December 4, 1914.

Immediately subsequent to the operation, the patient had some twitching of the right arm and the right side of the face (after the first operation, he had had some paralysis in the right arm and right side of the face). Since the second operation, five months ago, the patient has had no further convulsions, although it is too soon to consider that a permanent cure has been attained.

Several materials have been used in similar operations since the celluloid or metal plates were first employed to replace a deficiency in the skull and prevent adhesions to the cortex. Finsterer and Perthes have used hernia sac, Hanel has used prepared sheep intestine, Morris, Cargile membrane, Kirschner has reported seventeen cases in which he used fascia lata, after removing all the fat, Lexer employed a non-pedunculated fat-flap to prevent adhesions between the brain and scalp, and Binnie has reported a case in which he used a flap from the abdominal wall. The idea in this case was that the fascial flap alone would be more apt to reform adhesions to the exposed cortex than one in which the fat could be placed next to the cortex itself, the strong fascia lata replacing the fibrous portion of the dura and acting as a protection.

DR WM A DOWNES said that he had seen Dr Douglas put in this flap, and shortly afterward had a similar case, except that there was a bony defect 2 by 3 cm. On the first of January he had raised the scalp and found it adherent to the cortex. It was dissected off, and a fascial flap with its fat was inserted. The man had one convulsion the second day, but had had none since. The time, four months, was too short to draw any conclusions.

DR GEO WOOLSEY thought it quite possible that in Dr Douglas' case the recurrent epilepsy might have been due to the adhesions and the original epilepsy to the spicule of bone, and cited a somewhat similar case in which all that he had done was to remove the spicule. The patient had been operated upon, and on reopening the skull a spicule of bone projecting through the dura was found surrounded by a small

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cyst The last time he had heard of the patient, some years later, he was entirely well He had had convulsions during the post-operative period, for at that time hammer and chisels were used and there was a good deal of trauma In two cases this winter he had used the fascial flap, not having so much fat on the flap as Dr Douglas had had It was too early yet to say what the result would be One patient had been previously operated upon by himself and a piece of celluloid inserted The result as far as the epilepsy went was good The reason of the second operation was that overlying the celluloid, between it and the scalp, there was a collection of fluid which caused a marked bulging of the scalp There was no infection, and underneath the celluloid there was no fluid The other case had a large area extending well down beneath the temporal muscle from near the midline, so that a long narrow fascial flap had to be used

DR WILLY MEYER said that some time before he had presented to the Society a young man with an old compound fracture of the skull, followed by traumatic epilepsy After trephining, the adherent dura was freed and a piece of celluloid implanted It healed in nicely Two years later, epileptic attacks returned The skull was re-entered and it was found that the large celluloid plate had healed in perfectly It was removed and the motor centre of the arm resected, and the plate was re-implanted, that also healed, but the patient was not cured of the epilepsy Certainly, the recent method of transplanting the fascia is preferable to heterogeneous material

### ECHINOCOCCUS CYST OF KIDNEY

DR WM A DOWNES presented a man, forty-nine years of age, who for fifteen years had complained of pain and a mass in his left side The condition had been variously diagnosed as due to spleen or kidney, but barring one or two attacks of some discomfort the patient had had no serious trouble up to two years ago, when the attacks became more frequent and the large mass interfered with his going about and attending to his business He was admitted to St Luke's Hospital, April 6, 1915 Examination showed a smooth, non-fluctuating mass filling the entire left side of the abdomen Catheterized specimens of urine from kidneys left, alkaline, pus, trace albumen, urea much diminished, right, acid, no albumen, urea normal Culture negative Urinary flow right, normal, left, rapid Blood examination showed no eosinophilia Operation, April 13 Transverse kidney incision Kidney found to be seat of thick-walled cyst which was very adherent and was separated from the descending colon with difficulty Convalescence slow, but entirely satisfactory

## WIRING OF PULSATING TUMOR OF CHEST

### RESECTION OF STOMACH THROUGH TRANSVERSE INCISION

DR WILLY MEYER presented patients for whom stomach resections had been made through a transverse incision For description of these cases and discussion of the operative method, see page 573

### WIRING OF PULSATING TUMOR OF THE CHEST

DR WILLY MEYER presented a man, who for two years had been under the observation of Dr J G W Greeff, of the German Hospital An account of the case would soon be published by him The latter first saw the man in 1913, when the patient complained of shortness of breath, but said that he had suffered from that for four years, he had, however, of late been suffering with increased pain in the chest At that time he weighed 180 pounds On examination, the left lung was found to be normal Over the right there was hardly any breathing sound Only near the diaphragm was a zone of normal percussion On account of the flatness, he was aspirated, but this was negative Vocal fremitus was diminished An X-ray picture was taken and a large shadow found over the right portion of the chest, the heart had been pushed to the left, and it was reported that there was either blood or fluid in the chest

The patient was seen again in September, 1913 He had then lost in weight At that time, one year and eight months ago, there was found a small pulsating tumor in this region It appeared penetrating the fifth cartilage, also between the fourth and fifth rib interspace There was no history of lues The man had run down to 145 pounds

He was admitted to the German Hospital

In this case, at first glance, one would diagnose aneurism, but there was no thrill present, though there was distinct systolic expansion, and the diagnosis of aneurism could not properly be made The condition went on for a year and some months, without any tendency toward improvement To make things sure, aspiration was done at the base, and arterial blood was found It was explained to the patient that in order to do what was best the tumor should be wired according to the method that has been so thoroughly worked out by Lusk The only objection to Lusk's method is the preparation of the wire In one case presented by the speaker about a year ago, it took the house surgeon and another man sixteen hours to prepare the wire Having showed the patient before this Society, the speaker consulted with Dr Kauffer, a dental surgeon connected with the Harlem Hospital, as to whether or not one could improve on the preparation of the wire In two weeks he reported that he had found an improved method He winds the



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wire around a bottle of proper diameter, and covered with asbestos. Then an electric current is sent through, and the wire brought to red heat. After cooling, it retains its shape. Sixteen days ago, with the needle introduced under local anæsthesia, forty-five feet of wire were fed in, and then the electrolysis started. It takes one hour. The patient stood it nicely, and on the whole he seems to be improved. Formerly, he could sleep only in a certain position, and had to take morphine. Now he takes only half the former quantity, and can lie any way. He was brought down to show this new method of preparing the wire, which is an important advance over former methods.

The X-ray plates nicely show the coils of wire in a large cavity within the chest, hardly any in the tumor, projecting above the surface of the chest.

### FINAL RESULT OF ARTERIOVENOUS ANASTOMOSIS (FEMORAL) FOR GANGRENE OF FOOT

DR. WILLY MEYER presented a man who he said had been shown to the Society some two years previously. The trouble began on the right foot, and at last healed, when the same trouble developed on the other foot. The man suffered so that he could not sleep at night. Operation was indicated, but not wanting to amputate and not knowing of anything else that could be done, arteriovenous anastomosis was performed, in the presence of the gangrene which he had at the base of the great toe, involving the metatarsal bone, considered to give a bad prognosis. A typical Carrel operation was done, exposing the vessels and ligating one side, an end-to-end anastomosis, which Dr. Meyer prefers to lateral anastomosis. The patient had so much pain following the operation that nine days later the necrotic bone was removed, of course without any Esmarch's bandage. To every one's surprise, there were then a number of vessels bleeding so freely that ligatures were required. From that time on, the patient's pain lessened. To-day, the patient was in splendid condition and able to attend to business.

### THE CONSERVATIVE TREATMENT OF GANGRENOUS PROCESSES OF THE EXTREMITIES

DR. WILLY MEYER read a paper with the above title.

# TRANSACTIONS OF THE PHILADELPHIA ACADEMY OF SURGERY

*Stated Meeting, May 3, 1915*

The President, DR JOHN GIBBON, in the Chair

## RESULT OF LATE NEURORRHAPHY

DR EDWARD B HODGE presented a girl who had been in the Widener Memorial School, under treatment for tuberculosis in the left knee-joint. During her stay in the School she fell from a small express wagon and sustained a bad compound supracondylar fracture of the right humerus. A good result was obtained with the arm in Jones' position. During the treatment it was found that she had complete wrist drop. There was complete paralysis of the musculospiral nerve. This was treated expectantly and three months later Dr Willard cut down upon the nerve, finding it contused but apparently not severed. No improvement in function followed. In January, 1914, 5 years after injury, the speaker cut down upon the nerve, traced it down and found that it had been completely sheared through, the proximal portion continuing past the elbow as a fibrous cord. The distal portion of the nerve was buried under muscle and adherent to the humerus below the fracture. After reaching into normal nerve tissue, the ends were united with 2 silk sutures with the elbow in acute flexion to relieve tension. Later a cast was applied with the wrist hyperextended and still later massage and passive motion employed. At the end of ten months some improvement was shown, and now at the end of a year and a half there is pretty fair power. She has nearly complete power in extension of the wrist, good supination, and everything but complete extension of the fingers. The case was reported to encourage late attempts at neurorrhaphy. At the time of operation there was partial reaction of degeneration in the muscles involved.

## OLD POSTERIOR DISLOCATION OF SHOULDER

DR HODGE presented a young woman who had been the subject of a posterior dislocation of the shoulder of unusual etiology, which had become replaced in an unusual manner. The shoulder was luxated either from receiving a blow with a broom in sweeping, or in the motion of putting the hand to the head to do up her hair. This was followed by complete disability, swelling and pain. Dr Hodge saw

## PHILADELPHIA ACADEMY OF SURGERY

the patient at the end of five or six weeks. The arm was swollen and painful and there was almost complete disability. Below the acromion there was a considerable gap, the elbow was against the chest and forward, the head could not be felt in the axilla. A series of skiagraphs demonstrated a posterior dislocation below the acromion. An effort to obtain reduction under ether was about to be made, when during the anæsthetization the nurse who was holding the patient's hand left it for a moment to attend to a detail of the service and the arm dropped off the edge of the table. When Dr Hodge grasped the arm to manipulate, he found the head already in the glenoid. Dr Wharton was in the next room at the time and he confirmed the reduction. The patient has had complete comfort since though she has greatly limited function.

### END RESULTS IN FRACTURES OF BOTH BONES OF THE LOWER EXTREMITY

DR RUTHERFORD L JOHN, by invitation, read a paper with the above title, for which see page 619.

DR GEORGE C ROSS, in connection with extension by the Steinmann nail, asked whether any of the Fellows had used a method for extension in this type of fracture when the fracture is so close to the ankle that the limb cannot be put in a box. The device consists of an old shoe with the heel and toe cut out. To this a piece of heavy cord is attached bearing 20 to 25 pounds weight. The shoe is laced around the man's ankle. This makes satisfactory extension and if persisted in gives very good results.

DR JOHN, in closing, said that the measurements were made from the lower border of the patella to the internal malleolus in all the cases. The old shoe method suggested by Dr Ross is valuable in quite a number of cases except where there is much œdema of the foot, under which condition there is considerable danger of sloughing. In the presence of possible sloughing a heavy felt placed over the instep before the shoe is laced up is of advantage. The Steinmann nail, however, obviates this danger (of sloughing) and causes no pain to the patient while it is in use.

### FRACTURES OF THE FEMUR, WITH END RESULTS IN SIXTY-TWO CASES

DR CARL R STEINKE read a paper with the above title, for which see page 610.

DR A P C ASHHURST said it is surprising to find, in these two

series of fractures of the leg bones and of the femur, that there is very little difference in the period of disability. One is apt to think of a longer period of disability following fractures of the thigh than those of the leg. He had recently been going over hundreds of case reports of fractures for the American Surgical Association, and had found that the period of disability in all fractures was much longer than is commonly supposed. Such results are not very creditable. It is only by studious and painstaking investigations such as these of Dr. John and Dr. Steinke that one is able to realize that the patients are by no means cured when they leave the hospital, but that often a long period of disability follows. It should be the object of surgeons not only to get good functional results, but to get such results in as short a time as possible.

DR. JOHN B. ROBERTS said that what Dr. Ashhurst had said was perfectly true and the reason is perfectly plain. Surgeons do not get good results in fractures of the lower extremity because most of these cases are put to bed and are not given mobilization early and massage all the time as is more apt to be done in fractures of the upper extremity. There are many illustrations to be found showing how few cases of fractures of the lower extremity are properly taken care of by orderlies, nurses and resident physicians, whereas, similar injuries of the upper extremity are more apt to be seen not only by the resident physician, but also by the chief. A study of the results reported by the British Fracture Committee and the reports of the Committee on Fractures of the American Surgical Association, shows that the great faults in the treatment of fractures are (1) want of anæsthesia and reduction, (2) want of early mobilization and gentle massage. It is not only the fractured bone that needs treatment always, but also the soft parts surrounding and near the bone. The neglect of the soft parts is largely responsible for many poor functional results. He had in his possession a series of pictures and clinical reports, obtained some years ago, in which there is very great anatomic deformity according to the photographs and X-ray prints, but good functional result. These patients were treated by men who believed in early mobilization and massage, but did not pay as much attention to the anatomical reconstruction of bones at the point of fracture as many American surgeons are accustomed to do. The great defects in treatment of fractures of the lower extremities have been, neglect of reduction under general anæsthesia, poor attention to the soft parts, and the want of proper early mobilization and light massage from the very beginning—light massage not the vigorous motions and knead-

## PHILADELPHIA ACADEMY OF SURGERY

ings used by the average graduate of a massage school for lazy manhood and overfed women. The fragments should first be put in place under anæsthesia, and then the soft parts given as much attention as surgeons have usually given to bad sprains and formerly gave to the bones alone in fractures which they personally treated in private practice. Such methods will greatly lessen the need for direct metallic fixation of broken bones. Post-graduate teaching should emphasize the non-operative treatment of fracture and hospitals should provide proper ward service for these injuries.

DR GWILYM G DAVIS emphasized the point to which Dr Ashhurst had called attention, namely, the period of cure, particularly in relation to the question of treatment. The charter of most hospitals requires that a person must be admitted to the hospital if application is made within twenty-four hours of the injury. The treatment of fractures by operative means is probably the result of the effort to shorten the period of disability. This attempt is going to be more definitely emphasized on account of the passage of the workmen's compensation act. There should be more definite means of treating patients after they have been discharged from the general hospital and have become walking patients until the time they are again able to resume work.

### SARCOMA OF THE CLAVICLE AND THE SCAPULA

DR A BRUCE GILL reported the following case which occurred in the orthopædic service of Dr Ashhurst at the Episcopal Hospital.

A woman aged fifty-one years presented herself complaining of a lump on her left shoulder and of pain in the shoulder, particularly on motion. The mass had first appeared about 4 weeks before her coming to the clinic and had gradually increased in size. For 2 years prior to her admission she had been having pain in her left shoulder on motion of the arm. This pain was sharp, paroxysmal, and was referred down the arm. It was relieved by heat and increased by massage and motion. The patient could ascribe no cause for the pain and the appearance of the tumor and stated that she had never suffered any injury to the arm or shoulder.

She was admitted to the Hospital on July 28, 1914. She was pale and poorly nourished and had been losing weight. On the top of her left shoulder in the neighborhood of the acromioclavicular joint was a mass about  $1\frac{1}{2}$  inches in diameter, rounded, soft, fluctuating, slightly red and warm, and slightly tender. It was not painful except on motion of the shoulder when the pain became severe. The X-ray plate (Fig

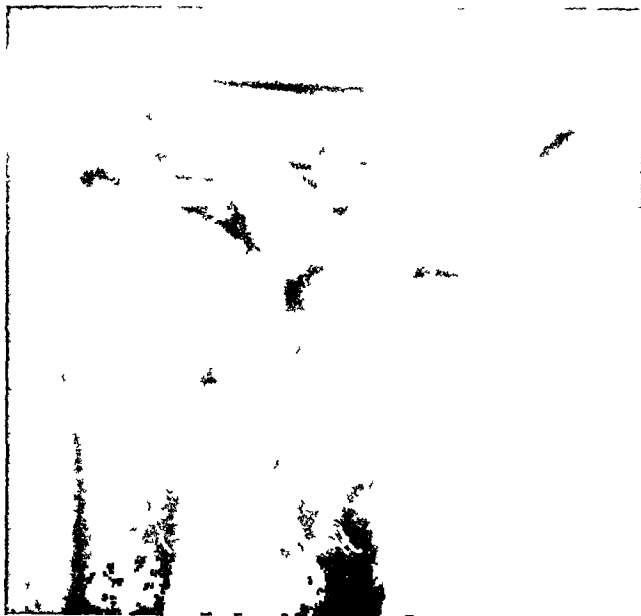


FIG 1 —Sarcoma of clavicle

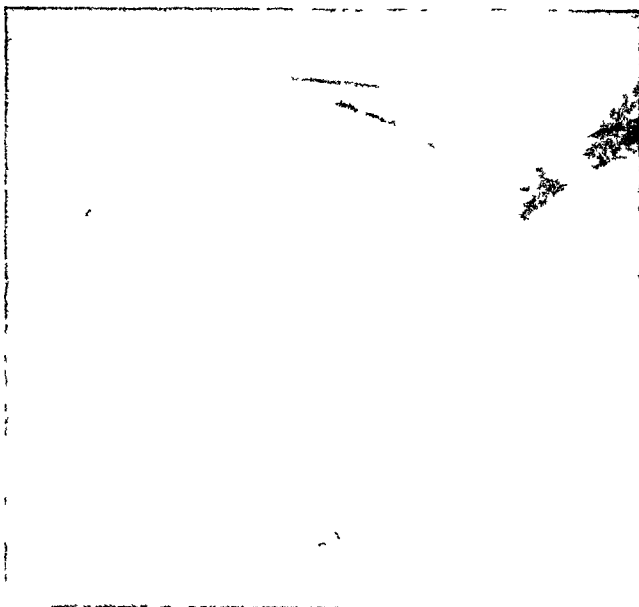


FIG 2 —Sarcoma of clavicle four months after first operation



FIG 3 —Recurrence three and one half months after first operation (November 5, 1924)



FIG 4 —Sarcoma of clavicle after excision of outer end of clavicle acromion and coracoid

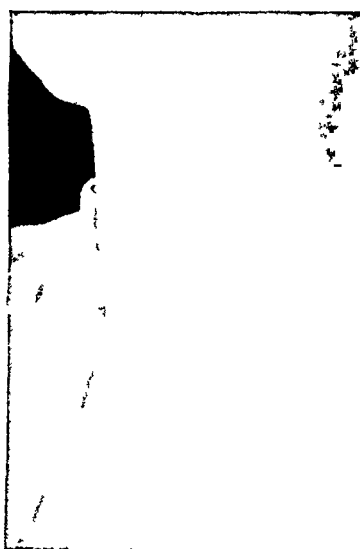


FIG 5 —Recurrence three months after second operation (February 8, 1915)

1) showed a mass about the acromioclavicular joint with possibly slight atrophy of the acromion and the acromial end of the clavicle. A tentative diagnosis of tuberculous abscess was made.

Operation was performed on July 29, 1914, by Dr. Gill. A curved incision was made in front of the tumor and a skin flap dissected upward. The tumor lay close beneath the skin and was soon penetrated. A mass of soft tissue resembling a soft blood clot in consistency but grayish in color oozed out abundantly. Hemorrhage was quite free. The tumor mass was cleaned out as thoroughly as possible with finger, sponges, and curette. It seemed to be enclosed in front, at least, by a thin capsule lined with large veins. The lower surface of the acromial end of the clavicle felt roughened. Otherwise there appeared to be no other bony origin of the tumor. Bleeding was controlled by packing tightly with iodoform gauze and a few sutures were placed to close the incision in part. Diagnosis was made of sarcoma of the clavicle. Microscopic section of the tumor showed it to be of the spindle-celled variety.

The use of Coley's fluid was begun shortly after the operation and was continued in ascending doses until considerable reaction was produced. The wound healed on August 18, 1914. But in less than 2 months the tumor gave evidence of recurrence (Figs 2 and 3). On November 7, 1914, Dr. Ashhurst operated and removed in one mass a third to a half of the clavicle, the acromion, and the coracoid process together with the surrounding soft tissues. More of the deltoid and trapezius muscles were then removed until no evidence of tumor remained. The skin was approximated and sutured with the arm abducted to a right angle.

The use of Coley's fluid was continued, and the wound was healed by December 19, 1914 (Fig 4). About the middle of January the tumor appeared to be recurring in the trapezius and the scapula.

On February 8, 1915, the tumor appeared as shown in Fig 5. At this time the mass was dark in color, owing to hemorrhage within the tumor substance. She was readmitted for operation. Spontaneous rupture of the tumor occurred after her admission and about a pint of blood was lost before the hemorrhage could be controlled by packing.

On February 17, 1915, Dr. Ashhurst performed the third operation consisting of complete excision of the scapula with the exception of the lower angle and the glenoid and of the trapezius half way to the occiput. Very little hemorrhage occurred owing to the fact that the line of incision was carried wide of the tumor. Part of the clavicle was removed although it did not appear to be involved in the tumor. The brachial plexus was freely exposed, but was not injured in the operation.



## PHILADELPHIA ACADEMY OF SURGERY

The skin was approximated and sutured again with the arm in abduction

The patient failed to recover consciousness after the operation and died three hours later Autopsy showed sarcomatous metastases in the lungs

Coley has reported 10 cases of sarcoma of the clavicle Of these 8 gave a distinct history of antecedent trauma In the case recorded above there is no such history Coley in his report (ANNALS OF SURG, 1913, p 556) of a case discusses the literature briefly and confirms his conclusions expressed in 1910 that

- 1 Primary sarcoma of the clavicle is one of the most malignant of all neoplasms

- 2 While a rare condition, it requires early diagnosis and very radical treatment

- 3 The mortality of the operation itself should be small

- 4 The danger of local and general metastases is very great

- 5 The use of Coley's fluid is strongly indicated as a routine measure immediately after operation

### GIANT-CELL SARCOMA OF PELVIS

DR GUY BLAIR DENIT reported the case of a lad, fourteen years of age, who was admitted to the Orthopædic Hospital under the care of Dr A P C Ashhurst He was complaining of severe pain in the right hip and small of the back Six weeks previously he had strained his back by lifting one end of an elevator weight, weighing 300 pounds That night he suffered severe pain in his back radiating from the lumbar region to the right hip In several days the pain ceased One month later, while playing at school, he was knocked down and struck his right lumbar region against a stone wall This caused him much pain and he was taken home and put to bed He remained in bed for a time, and then on crutches until December 1 On December 1 he was taken to a hospital and treated for rheumatic arthritis of the right hip He was admitted to the Orthopædic Hospital on December 28 On admission he was suffering with severe pain in the right lower quadrant of the abdomen and in the right hip His pain was paroxysmal in character, lasting an hour or more at a time He was a fairly well nourished boy about average size for age

In lumbar region on the right side there was a large mass, semisolid in consistency, occupying the whole of the right lumbar region and right lower quadrant of the abdomen On palpation this mass was extremely tender

An incision was made through the bulging mass in the loin, and a

## GIANT-CELL SARCOMA OF PELVIS

portion of the tumor was excised and sent to the laboratory for examination. The wound was sutured and drained without further operative procedure.

One specimen of the tumor was examined by Dr C Y White, director of the Pathological Laboratories of the Episcopal Hospital, and another by Dr E P Corson White, Pathologist to the Orthopædic Hospital. The report from both laboratories was that the tumor was a giant-cell sarcoma.

Matthew J Stewart (*Lancet*, 11, 1236) gives the following classification of giant-cell sarcoma. "Giant-cell sarcoma is used in its widest sense as a term to include all sarcomata in which giant-cells of blastomatous origin constitute an important part, it may be the essential feature of the microscopic picture. This large class is made up of two groups of cases (1) the myeloid sarcomata (myelomata of some authors) and (2) the malignant giant-cell sarcomata. The latter are equivalent to mixed-cell sarcomas, as there are cells of all sizes, but in some the giant-cells are so numerous as to justify special recognition in the term used. Giant-cells of the myeloid sarcoma resemble osteoblasts and clasts, not myeloplaxes or mononuclear giant-cells or bone marrow. Cytoplasm is abundant especially at periphery and presents a homogeneous ground glass appearance. Vacuoles mostly peripherally situated are often present and may be of large size when they not infrequently contain cell inclusion. The nuclei are uniformly small in size and when not closely packed together are round or oval in shape. There are no mitoses in these giant-cells even when mitoses are present in cells forming matrix of the tumor. The nuclei in smaller giant-cells and in many of the larger are uniformly distributed through the cytoplasm, but in larger giant-cells they often are grouped in the centre in 'whorls'. The peripheral ring-like distribution of the nuclei, so characteristic of tubercular giant-cells, is practically unknown in cases of myeloid sarcoma. N B There are no transitional forms between the giant-cells and other cellular constituents of the growth, every cell is either a giant-cell or not a giant-cell without any doubt whatever.

"In malignant giant-cell sarcoma, as in myeloid sarcoma the stroma may be round, spindle or mixed celled, and as in it the number of giant-cells varies greatly in different parts of the same growth. Cells of the stroma are very irregular and almost always one can find transition forms from smallest to the largest. Mitoses are very frequent both in giant-cells and in the matrix. The giant-cells and especially their nuclei are the chief distinguishing characteristics. The nuclei are extremely irregular in size and shape often presenting lobes and indentations while most of them are of large size. Enormous nuclei may

## PHILADELPHIA ACADEMY OF SURGERY

be met with and the giant-cells may be mononuclear. The number of nuclei seldom exceeds six, and most cells have from one to five only. Usually they are clumped together and it may be difficult to count them precisely. Vacuolation of cytoplasm is rare."

The tumor in this case belonged to the first group of cases, the myeloid sarcomata.

On January 22, three weeks after the operation the first injection of Coley's fluid was administered. The first injection, 1/10 minim, was given into the buttocks. Seventeen weeks after the beginning the dosage had been gradually increased until minims 42 were being given. At no time during these weeks were the reactions severe. He was then given a rest from treatment for a period of three weeks, at the end of which time the injections were resumed, beginning with minims 42 and gradually increasing the dosage until minims 48 were being given. Again he was given a rest over a period of three weeks, at the end of which time the injections were resumed, beginning with minims 48. From this time on the reactions were rather severe, the temperature often going above 102° and at times reaching 103.2°. Chills accompanied the temperature and there was always severe pain at the site of the needle puncture.

The injections were discontinued on September 18, 1914, eight months after the beginning of the treatment, at which time he was given minims 56. This caused a severe reaction, the temperature going up to 103.8°, and a severe chill accompanied the temperature. However, his condition was at no time alarming.

As stated before, the injections were given over a period of eight months with only six weeks rest from treatment. As a rule these injections were given every other day, however, three or four days often elapsed between injections.

The fluid was first injected into the buttocks. First on one side and then on the other. They were then given nearer and nearer the tumor until the tumor in the loin itself was injected. There was always severe pain at the site of the needle puncture and often marked skin reactions. The constitutional reactions were on the whole very mild, but at times they were rather severe. At no time was it necessary to give stimulants, but morphine, codeine and aspirin were frequently given for the relief of pain. At no time were the injections given daily. Twice the patient was given a rest of three weeks from treatment, during which time his general condition improved a great deal. The bowels were always kept open and tonics were given at intervals during the treatment. The injections were given deeply in and around the tumor in the loin and at no time were the reactions so severe as to cause alarm.

## GIANT-CELL SARCOMA OF PELVIS

The directions as prepared by Dr Coley were followed except as to dosage, as stated before, the first injection was minim 1/10, and the highest dosage was minims 56, this being, so far as I can find out, the highest dosage of the fluid that has ever been administered. In a recent letter received from Dr Martha Tracy, of Germantown, Phila., whose preparation of Coley's fluid was used, she states that the highest dosage that has been administered by Dr Coley himself was minims 26, but states that she knows of one surgeon who has given as high as minims 30. She further states that Dr Coley believes there are few cases in which minims 26 would be safe. In a statistical study prepared by Dr Tracy she finds about ten per cent of the cases of sarcomata in general are benefited by the treatment.

Results of the treatment. As to the actual time in which the tumor began to diminish in size it is somewhat difficult to state owing to the position of the tumor. However, there was marked diminution in the pain two weeks after the first injection, at which time the patient was allowed to sit up several hours daily. Soon after this he was able to walk around the ward without discomfort, but he had a distinct limp on the right side. There was always a local reaction at the site of the tumor when the injections were made into it. This mass retained its somewhat semisolid consistency until the last of September, at which time it began to become softer and softer and increased in size. Several days later the mass broke down and discharged through the scar of the incision in the loin. From this time the mass in the loin diminished in size and became harder and harder in consistency and at the time the injections were discontinued the mass had the consistency of a bony tumor. This tumor seemed to be adjacent to the fourth and fifth lumbar vertebræ in the right loin.

The patient was discharged November 10, 1914. He had none of the symptoms which were so prominent on admission. No tumor could be palpated through the abdominal wall, the mass in the loin had decreased in size and assumed the form of a bony tumor. There was no pain on walking or running. His general health had improved a great deal. A skiagraph taken at this time shows a small tumor adjacent to the fourth and fifth lumbar vertebræ.

On December 1 the patient was readmitted to the Hospital for examination. There was no sign of an increase in the size of the tumor. There had been no return of pain or lameness. A skiagraph taken at this time shows the tumor to be about the same as at the time of his discharge in November.

At the present time the patient goes to school, he rides a bicycle, plays base-ball and has no difficulty in running and playing. There

## PHILADELPHIA ACADEMY OF SURGERY

has been no return of pain. He now weighs 103 pounds, while at the time of his discharge he weighed 76½ pounds. A skiagraph taken May 1, 1915, shows that there has been no change in the size of the tumor since his discharge in November, 1914.

DR A P C ASHHURST called attention to the marked contrast between the cases reported by Dr Gill and by Dr Denit, the former a typically malignant sarcoma, and the latter a so-called giant-cell sarcoma. In both the tumor was curetted, and the patients were treated by Coley's fluid. In both patients, likewise, the tumors recurred after operation in spite of this treatment. But in the case of the woman (Dr Gill's case) death followed the operation for the second recurrence, only 7 months after the first operation, while in the boy (Dr Denit's case) the recurrent tumor gradually melted away under the influence of the toxins, seemed to become more and more bony, and the patient is at present apparently in perfect health, more than 7 months after cessation of treatment, and 17 months after the first and only operation.

As to the real nature of giant-cell sarcomas, many papers have been written by surgeons setting forth their views, but the pathologists really are wiser, for like Socrates they admit that they know nothing. In the *Lancet* some months ago is a paper by Stewart (*Lancet*, 1914, II, 1236), the Clinical Pathologist at the Leeds General Infirmary, based on a study of about 50 cases of giant-cell sarcoma. He concludes that the benignancy or malignancy of the tumor can be predicated absolutely upon the characters of the giant-cells present, whereas it is Bloodgood's contention that it is the stroma which is especially characteristic, and that in the benign growths it resembles granulation tissue. Then there is Barrie of New York (*ANNALS OF SURGERY*, 1913, I, 244) who goes still further, claiming that it is really granulation tissue, and calling the disease hemorrhagic osteomyelitis.

### AN ANATOMICAL STUDY OF FEMORAL HERNIÆ

DR T TURNER THOMAS read a paper with the above title, for which see page 582.

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# ANNALS *of* SURGERY

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## HÆMANGIOMA OF THE SPINAL CORD

ASSOCIATED WITH SKIN NÆVI OF THE SAME METAMERE\*

BY STANLEY COBB, M.D.

OF BOSTON, MASS

HÆMANGIOMATA of the spinal cord and its membranes are rare, and in the published lists of cord tumors no record is found of their occurrence (viz, Schlesinger's list<sup>15</sup> of 400 cases and Flatau's<sup>14</sup> of 213) A thorough review of the literature, however, brings to light seven cases beside the one here reported

GAUPP,<sup>1</sup> in 1887, describes two cases in an inaugural dissertation embodied in *Ziegler's Beiträge* for that year The first has no clinical history, and tells of the finding at autopsy of an angioma on the cauda equina measuring three by two cm, above this point in the cord were two neurofibromata, and a glioma with syringomyelia in which was a fresh hemorrhage He considers that these three different tumors each arose from an embryonal defect in the cord

His second case<sup>2</sup> is more interesting and gives the history of a woman of forty-five who had a condition diagnosed as "spinal meningitis" at twenty-one, followed by weakness of her legs, and paræsthesia slowly increasing for ten years, during the next four years she could limp about, and then both legs suddenly became spastic and anæsthetic with motor and vasomotor paralysis, and incontinence of urine and fæces This condition improved a little during the next few months, but for ten years more she was a cripple and finally died of decubitus infection The post-mortem examination showed a widening of the spinal canal in the lower dorsal and upper lumbar vertebræ, with a large varix of veins arising from the pia which pressed upon and flattened the spinal cord

The next case reported is one by BERENBRUCH,<sup>3</sup> in 1890, in another inaugural dissertation, at Tübingen This patient, a boy of sixteen, was born with lipomata showing on his left side over the pectoralis muscle, on the right scapula, and along the latissimus dorsi on the right, these increased in size as he grew older, and at the time of the onset of the paralysis were quite deforming, the one on the right scapula being as large as a boy's head, and the one over the latissimus dorsi, though less prominent, made that whole side of his back appear enlarged One day after severe exercise he felt weak and tired in his legs, this persisted, and he had lancinating pains down both legs, at the end of two weeks he was entirely paralyzed in the right leg and partially in the left, with increased tendon reflexes and clonus Sensory perception was dulled, but not lost, up to the middle of the abdomen A diagnosis of lipoma in the spinal canal was made, and he was operated on two and a half months after the onset of the disease,

\* From the Surgical Clinic of the Peter Bent Brigham Hospital, Boston

but the three-hour operation exhausted him, and death followed in four hours. Autopsy showed that beside the three superficial lipomata, there was a large cavernous plexus of veins along the spinal column connecting with the two tumors of the back outwardly, and with an angioma of the dura by way of the intervertebral foramina. Furthermore, there was an angioma of the cord substance itself extending from the fifth cervical to the third dorsal segment, and in parts of this were extravasations of blood. Lastly the capsule of the right kidney showed a small angioma. All of these vascular tumors were made up of large and small blood-vessels, the external ones were mixed with fat, the dural with connective tissues, while the cord tumor was a pure hæmangioma.

In 1895 GERHARDT<sup>4</sup> reported a case in great detail. The patient was a man of eighteen, his first symptoms were weakness of the right foot and lower leg, followed eight days later by weakness of the left, "cramps" were then felt in both legs for a few days, while the weakness spread upwards until the whole of both legs was involved and walking became impossible. It was then found (four weeks after the onset) that anæsthesia was present up to the knees. Two months later the paralysis was total in both legs with loss of vesicle and sphincter control, and six months after the onset, hypæsthesia and paræsthesia extended up to the level of the navel, the knee and ankle jerks became exaggerated, and contractures developed in the leg muscles, with a thoracic scoliosis and lumbar kyphosis. For the next two years there was little change except that the hypæsthesia became total anæsthesia and the contractures increased. During the third year the joints became ankylosed, and in the fourth year the deep reflexes were lost. Finally erysipelas developed from a decubital ulcer, and he died in the sixth year of the disease. At autopsy a vascular tumor, diagnosed by von Recklinghausen as angioma, was found pressing on the cord at the level of the fifth and sixth thoracic vertebræ.

HARMAN AND BALK<sup>5</sup> reported a case in 1900. This was another long drawn-out story of a man who began by having pain in his legs, this lasted four or five months and then the pain suddenly increased, he lost motor power in his legs and opisthotonus developed. These symptoms gradually passed away in six months. Two years later he had a similar attack, but at the end of five months he was able to walk, though lame. His third attack came two and a half years later, and was at first slight, only interfering with locomotion for two weeks, but then, while in bed one day, he had a sudden great pain with retraction of the head, followed by difficulty in swallowing and articulation, later his sphincters became paralyzed, and in ten days he was dead. Autopsy showed a large blood clot in the spinal canal overlying the lumbar cord where there was found a cavernous angioma of the pia.

A year later LORENZ<sup>6</sup> had a case in Jena. A woman of twenty-seven, who first noticed weakness of her left hand. Two days later she suddenly collapsed with a sensory and motor paralysis of both legs, partial in both arms, and in a few hours her breathing became labored and she died two and a half days after the onset of the first symptom. The post-mortem examination disclosed an angioma of the pia, about the size of a cherry, at the level of the seventh cervical root, and a hemorrhage into the arachnoid space and cord substance from the first cervical to the fifth dorsal root.

The last case is one reported in 1903 by HADLICH<sup>7</sup>. This, like the first of the series, was an accidental autopsy finding. A woman of thirty-five, dwarfed and with a narrowed pelvis, died after Cæsarean section. At autopsy an angioma of

## HÆMANGIOMA OF THE SPINAL CORD

the pia was found in the lumbar region, it invaded the cord substance somewhat and caused marked distortion, but no hemorrhage was present

**CASE HISTORY**—E A P, an eight-year-old boy of Swedish extraction, entered the medical service in the Children's Hospital on May 23, 1914. Previous to the onset of the present illness, he had had a rather varied medical career, he was a full term, normally delivered child, well and vigorous during his first year. He then had measles, followed six months later by typhoid with bloody diarrhoea, during his convalescence, he sprained his right knee and was lame for a month, and then, at two years of age, he developed pertussis. During his third year he was well except for an enlarged lymph-node behind the angle of his right mandible, which disappeared without operation after several weeks. When he was four years old, he suddenly screamed with pain, complaining of his lower abdomen, and on examination a hernia was found in the left inguinal region, which was reduced with chloroform, for this he wore a truss for a year, and there has been no recurrence. From this time until he was eight years old, he enjoyed a healthy, normal boyhood.

*Present Illness*—On May 15, 1914, he was suddenly stricken, while playing ball, with a sharp pain in his lower back, causing him to cry out. He was taken home feeling weak and nauseated, but without fever. He vomited once during the night after taking some medicine, but the main symptom was pain in the back, radiating into the lower abdomen. In a few hours this had subsided, but he did not feel well for the next four days, and was kept out of school. He then returned to school, apparently well, but three days later a similar sudden pain in the back attacked him, more severely than the first time, and for several hours he screeched and rolled about in agony. As this severe attack subsided, he said that the left foot felt numb, "as if it was asleep," and this gradually spread up the leg to the thigh, and then "down the other leg," till at the end of fourteen hours both lower extremities were numb and paralyzed. It was noted definitely that the left leg first became numb, but in which leg the paralysis first appeared is not known. The next morning it was found that the anal and vesicle sphincters were also paralyzed, there being incontinence of faeces and retention of urine, necessitating catheterization. On this day, May 23, eight days after the onset, he entered the Children's Hospital, with a presumptive diagnosis of anterior poliomyelitis.

*Physical Examination*—This showed a flaxen-haired, blue-eyed boy well nourished and well developed, with a deep depression at the lower end of the sternum, and a birth-mark of the "port wine" variety on the left back. The neck was held stiffly and was perhaps slightly tender. The abdomen was also held



stiffly, but the liver edge was palpable, and a mass above the pubes, evidently a distended bladder. Both legs showed a complete flaccid paralysis, with absent knee-jerks, and no ankle clonus, Babinski, or Kernig.

Sensory examination revealed analgesia up to the level of the umbilicus, and anæsthesia except for the soles of the feet, where a sharp pin prick was felt dully. The abdominal reflexes were absent, and the cremasteric were sluggish. There was incontinence of urine. A lumbar puncture was done, and 40 c.c. of spinal fluid were withdrawn under increased pressure, showing twenty cells per cubic millimetre, 85 per cent of which were

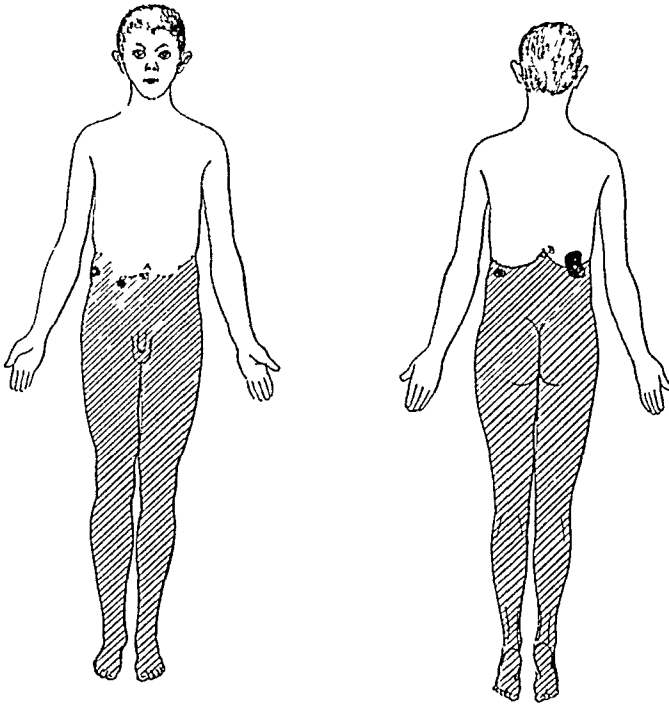


FIG. 2.—Diagram showing area of anæsthesia and position of navi. A, umbilicus; B, spinous process of first lumbar vertebra; ■, navi; ///, anæsthesia area.

mononuclear, and 15 per cent polymorphonuclear. A von Pirquet skin test was positive in twenty-four hours, the leucocyte count was 15,000, and hæmoglobin (Sahli test) was 82 per cent.

*Course of Symptoms*—For the first six weeks the paralysis was of a flaccid type, so the supposition that the disease was poliomyelitis was a natural one. Priapism was first noted on June 1, and persisted until after the operation. Then on July 3, a slight return of the knee-jerk in the right leg was noted, this leg was less flaccid and did not seem to fall so limply as previously. On July 4, stimulation on the soles of the feet caused flexion of the knees and ankles, and on the sixth the right knee jerk was ex-



FIG 1 —Photograph six weeks after operation showing upper level of anesthesia (dotted line) crossing lower portion of nœvus and operative incision (between crosses)

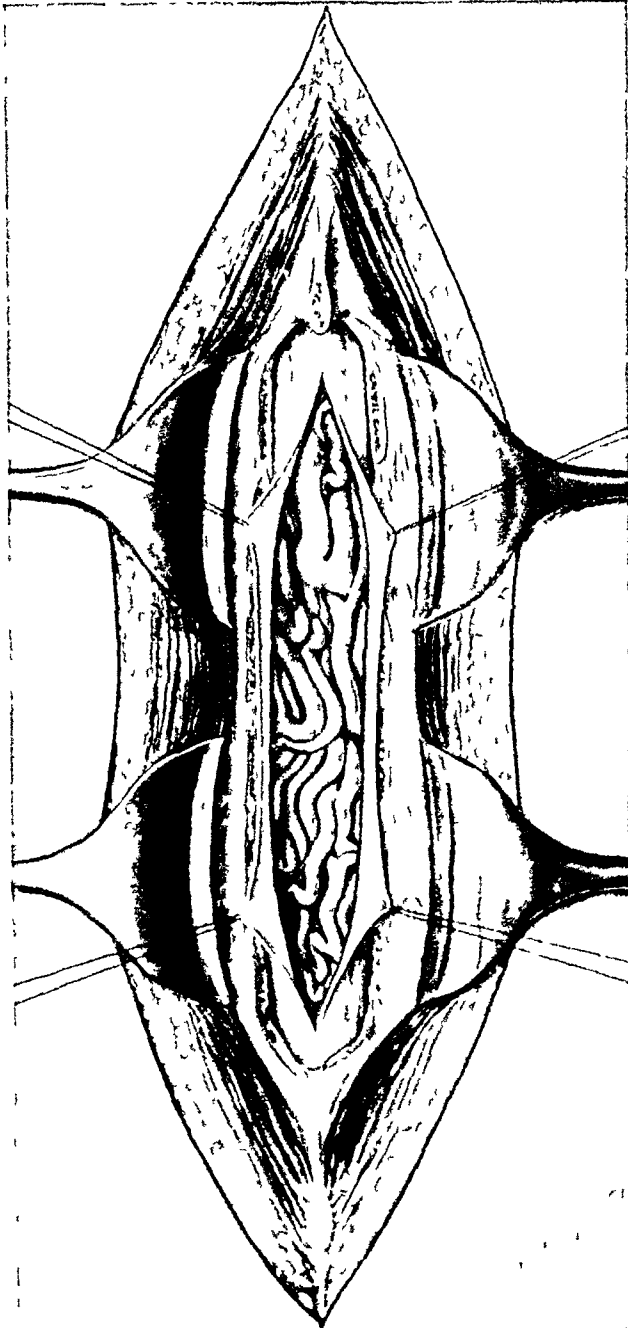


FIG 3 —From sketch made at operation showing incised dura with hamangioma beneath (about one half natural size)



aggrated, and ankle clonus was obtainable on the right, appearing on the left two days later

On August 4, Oppenheim and Babinski reactions were found in both legs, the paralysis thus becoming completely and typically spastic ten and a half weeks after the first paralysis developed. During this time there was no return of voluntary muscle power or sensation, the anæsthetic area still extending up to the umbilicus. A swelling along the right side of the vertebral column from the fourth to the eighth dorsal vertebra was noted on September 17, but an X-ray of the chest was negative.

He was transferred to Professor Lovett's service on September 21 with a diagnosis of spinal cord tumor, and the following notes were recorded: "As he lies in bed the spine shows quite a marked right dorsa-lumbar scoliosis, and the ribs on the right side, posteriorly, between the scapula and spine, are more prominent than on the left. The patient is unable to sit or stand on account of loss of power of the supporting muscles of the back and abdomen. The trochanters are very prominent, with atrophy of the gluteal muscles. The Achilles tendons on both sides are contracted, holding the feet in moderate equinus. The Wassermann reaction on the blood is negative." On an exchange visit, soon after this, the patient was seen by Dr. Cushing, who ventured a diagnosis of congenital dermoid or hæmangioma, he based this on the fact that the skin nævus on the child's back lay in the same metamere as the presumed tumor of the spinal cord (Fig. 1).

On October 16, the patient was transferred to the surgical service at the Peter Bent Brigham Hospital. The neurological and general physical examinations here revealed nothing new, except that three more small nævi were noted about the trunk at the level of the umbilicus. The epigastric reflexes were present, but the abdominal and cremasteric were absent. The knee-jerks were hyperactive, ankle clonus was present on both sides, and Babinski, Oppenheim, and Gordon reactions were all obtained in both legs, but more markedly in the left. The sensory disturbances showed no change, anæsthesia extending up to the umbilicus anteriorly, to the tenth rib laterally, and posteriorly to the level of the first lumbar vertebra (Fig. 2). It was, however, noted that the toes showed some sense of position, more in the left foot than in the right. The urine was cloudy and showed many pus cells and a slight trace of albumen, the leucocyte count was 19,000, the hæmoglobin was 80 per cent, the pulse ranged from 80 to 120, and the temperature from 98° to 100.2° Fahrenheit.

Dr. Cushing's note on the day of operation follows:

"This child shows a transverse paraplegia with the upper level of anæsthesia about at the tenth thoracic level. It has been presumed, owing to the acute onset of symptoms, that the case was

one of poliomyelitis of an unusual type. However, the definite upper level of anæsthesia, the complete lower limb paralysis with exaggerated reflexes, visceral paralysis, and priapism, make it fairly definite that there must be pressure against the cord. Examination shows a slight scoliosis with prominence of the spinal muscles at the scapula level, and over the lower portion of the right scapula there is a nævus about 5 inches in diameter. The presumptive diagnosis is of a congenital lesion pressing upon the cord, either a dermoid or an angioma. Similar meningeal angiomas have been observed by myself in association with facial nævi."

*Operative Note*—October 30, 1914 *Exploratory laminectomy Angioma* "A long median incision was made with removal of the laminae, possibly from T6 to T10 inclusive. The exploration was simple and dry. The exposed dura was bulging, and it was the operator's impression that the canal was much wider than usual, particularly for a thoracic region, and that the laminae were unusually broad, flat, and thin.

"The exposed dura was tense, bulging, and transmitted an unusually dark subdural coloration. Fortunately great pains were taken to enter the dura without injuring the arachnoid, for a careless entrance would certainly have injured some of the enormous vessels which were disclosed on opening the meninx. Such of the arachnoid membrane as could be identified was more or less adherent to the dura by fine adhesions which readily broke down as the dura was drawn to each side. This exposed an extraordinary tangle of huge pulsating vessels filling the canal (see Fig 3). It was possible in a few places to see the normal coloration of a very flattened spinal cord, through and below the mesh-work of vessels.

"It seemed futile to attempt to ligate any of the vessels, and the dura was therefore left widely open, and the wound closed as usual in layers, without a drain."

The patient made a good ether recovery, but had a very uncomfortable convalescence. Careful watch was kept of the sensory disturbances, but no definite improvement was noted at any time. Three days after operation the priapism was still present, but on the fourth it disappeared, and has not returned. This is, unfortunately, the only symptom relieved by operation, the spastic paralysis, incontinence, and anæsthesia remaining. Some slight sensory changes appeared from time to time. At first the level of response to a heavy pin prick seemed to spread down the right leg as far as the groin, anæsthesia for light touch remaining at the level of the umbilicus, the muscle sense in the toes seemed to be more acute, and he could tell quite well in what position his toes were placed. On November 22 it was noticed that the right foot

was definitely colder than the left, and this condition continued until about December 14. On January 26 a spontaneous fracture of the femur occurred, and an X-ray showed extreme atrophy of the bones. So as time wore on, and no recovery seemed possible, it became a struggle against decubitus and cystitis.

A neurological examination on April 16 showed no change, except that there was a band of hyperæsthesia at the upper limit of the anæsthesia, and on the right a segment within the area of protopathic anæsthesia, where light touch could be felt. At the present writing (June 15) the patient is at home in unchanged condition.

*Discussion*—This series of seven cases, though small, permits of a comparison which brings out some points of interest. The onset is usually slow, the paralysis not reaching its maximum for days or even months. In two instances, weakness of the feet was the first symptom, preceding paralysis of the legs by two weeks and by six months, in another, weakness of the right hand preceded the paralysis by two days. In three of the cases pain came on suddenly but was not followed by the paralysis for five days in one, two weeks in another, and five months in the third. A history of recurrent attacks after partial recovery appeared twice, while in four of the cases a single attack seemed sufficient to cause a permanent paralysis. Four of the histories note an onset with flaccid paralysis, described as "weakness," the spastic symptoms not coming on for a considerable time—two months, six months, and fourteen years in three of these, while in the fourth the patient died in the flaccid state. In short the symptomatology appears to be that of hemorrhage into the spinal cord or canal, generally recurrent if the patient survives the first paralysis. Death in two of the cases was due to respiratory failure, in two to decubitus, and in two others to operation, while one has no clinical history, and the other patient is alive at the present writing.

Pathologically it is striking that in all of the cases the tumor involved the pia, in two the dura was also involved, and in two the cord substance was invaded. The level of the angiomas on the cord is variable, three were lumbar, one cervical, one cervicodorsal, two dorsal, and one was found on the corda equina. The tendency seems, therefore, to be towards a low position. In two of the cases there was widening of the vertebral canal in the region of the tumor.

One of the most interesting features of the case here reported is the occurrence of nævi on the skin in the same metamere as the angioma of the cord, that is to say, the membranes of the spinal cord in the vicinity of the tumor are supplied by the same nerve roots as the skin on

which the nævi are found. In none of the other cases was a similar observation made, unless the lipomata and deep angiomata in Berenbruch's<sup>3</sup> case may be so considered, but nævi may have been present and escaped notice, or may have been noticed and not thought worthy of record. In searching through the literature on nævi, one case<sup>8</sup> is found where a large angioma of the right flank, in the sensory distribution of the eleventh dorsal segment, was associated with atrophy of the right leg, since this is the opposite of the usual condition of hypertrophy found with angiomata of the skin, it is possible that here is a case where an associated tumor was pressing on the lower dorsal cord, this is only hypothesis, however, as no autopsy was performed. Although no literature is obtainable on the association of nævi with cord tumors, an article by Cushing,<sup>9</sup> in 1906, entitled "Cases of Spontaneous Intracranial Hemorrhage Associated with Trigeminal Nævi," throws much light on the subject. He cites three cases observed by himself, and three other cases found in the literature, where facial nævi were associated with vascular tumors of the cerebral meninges, another case reported by Kalischer,<sup>10</sup> in 1901, brings the total up to seven. Skin nævi have also been found in association with angioma formation in the liver,<sup>11</sup> and in Berenbruch's case,<sup>3</sup> an angioma of the kidney capsule was present.

The subject of the metameric distribution of nævi has been taken up by numerous writers of the French School. Bärensprung,<sup>12</sup> in 1863, made the original communication, describing the topographical distribution of nævi and drawing attention to their development in definite connection with territories of cutaneous innervation. He believed the lesion to be a congenital one of the spinal ganglia because the cutaneous alteration consists in a hypertrophy of the elements in which the peripheral nerves terminate, *i e*, the pigmented layer of the skin where the free nerve endings lie, and the blood-vessels of the papillary layer which also receive nerve filaments. Etienne, in 1897,<sup>13</sup> took up the subject thoroughly, and came to a similar conclusion that a nævus represents an intra-uterine nerve lesion. No one suggested, however, that organs other than the skin, but in the same segment of nerve distribution, could be similarly affected, until the publication of Cushing's article,<sup>9</sup> in 1906. The case in hand seems to substantiate this view, since it shows its application to nerve distributions other than the trigeminal, for in this case, four nævi were found on the skin, three on the right and one on the left side, in the cutaneous area supplied by the seventh, eighth, and ninth dorsal segments, and at operation the vascular tumor was seen to overlie the cord from its fourth to ninth

segment, while the upper limit of anæsthesia is at the level of the ninth dorsal segment. As only an operative incision was made, it is impossible to tell whether or not the angioma extended farther up and down the cord, but from the symptoms it is evident that the main lesion—probably a hemorrhage—was at the ninth dorsal level.

*Conclusions*—(1) Skin nævi are at times of diagnostic value when segmental phenomena referable to the central nervous system are present.

(2) Congenital blood-vascular tumors apparently arise from a developmental fault of the central nervous system, so these lesions may occur in any of the organs innervated by filaments from that neuromere.

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# THE CONSERVATIVE TREATMENT OF INTRINSIC CANCER OF THE LARYNX BY THYREOCRICOTOMY (TOTAL LARYNGOFISSURE) OR THYROTOMY (PARTIAL LARYNGOFISSURE)

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THE treatment of malignant growths in regions where the lymphatics are abundant and lymphatic drainage territories ill defined, has shown in recent surgery two distinct tendencies one to a radicalism that is disabling, the other to a conservatism that is merely palliative. The *former* tendency is well illustrated by the so-called block dissections, in which, for cancer invading the tongue, it is recommended to remove that portion of the inferior maxilla and floor of the mouth contiguous to the site of the lingual lesion, and, in addition, all the glands in one, sometimes both sides of the neck. This is a serious operation, the disfigurement after healing is severe and distressing, and often both surgeon and physician are disappointed to find the growth has recurred in the scar or in some lymphatic node that has escaped observation or is inaccessible. The *latter, i e*, the conservative course, is adopted by many surgeons who feel that, in tongue cancer, for instance, if the disease cannot be removed with a fair degree of thoroughness by an operation of moderate extent, it is better to attempt none or only palliative surgical measures.

The treatment of cancer of the larynx will follow one or the other of these courses, depending on whether the disease is extrinsic or intrinsic. In *extrinsic* cancer (Fig 1), *i e*, growths located on the interarytenoid space, aryteno-epiglottic folds, epiglottis, or pyriform fossæ, the disease spreads rapidly, metastases occur earlier, and for their radical removal a complete laryngectomy after the method of Gluck or some modification of that method is demanded. This operation is severe, crippling, destroys the voice, and is comparable to the block dissections referred to. While recurrences frequently follow, still the results in complete laryngectomy appear to be much better than those following operation of the tongue, for example, due in part, at least, to the fact that cancers of the larynx soon give evidence of their presence by definite symptoms relating to the voice or swallowing. Further, they are watched by skilled specialists and detected in their incipient

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stages, while mouth, tongue and cheek cancers often remain under the care of the family practitioner or are for some time disregarded entirely. Most important, however, is the lymphatic distribution, to be referred to later, which is so arranged that for a long time complete removal is possible.

*Intrinsic* cancer, on the other hand (Fig 1), *i e*, cancer located on the true or false cords or somewhere below that level, is amenable to comparatively simple surgical procedures without great crippling and with a certainty of cure that surpasses cancer in almost any other situation—facts first demonstrated by Butlin and Semon, and more recently by an increasing number of observers with almost constantly improving statistics.

It is the purpose of this short paper to restate and emphasize the value of conservative surgery in the treatment of these *intrinsic* cancers, to point out that the work may be undertaken by the general surgeon in conjunction with the laryngologist, to briefly describe the steps of the operation and to report several cases illustrating the good results that may be expected.

The *lymphatic* vessels (Figs 2 and 3) and nodes of the larynx, which, no doubt, play a most important part in the dissemination of cancer, are described by Most as follows. The network of lymphatic vessels in the larynx is separated almost entirely into a supra- and subglottic area by a horizontal non-vascular streak, a sort of *lymph-shed*, following the vocal folds (cords) (see Fig 2). The only lymph-vessels connecting the two areas are those forming a rather rich network in the mucosa of the posterior laryngeal wall.

The supraglottic lymphatic area is somewhat richer than the subglottic, being more fully developed in the ventricle of the larynx and upon the ventricular folds (false vocal cords) than elsewhere. Above it is continuous with the lymphatic network of the epiglottis, below it is continued into the subglottic area by means of the vessels in the mucosa of the posterior laryngeal wall. The network becomes very scanty upon the upper surface of the vocal folds and upon their free margins is lost altogether.

The subglottic lymphatic area consists of more delicate vessels than the supraglottic, although, in general, the meshes are somewhat closer. Below it is continuous with the tracheal lymphatics, above it is continued posteriorly into the supraglottic area, but latterly it is lost at the summit of each vocal fold.

From the supraglottic lymphatic area, three to six efferents pass from the lateral region of the epiglottis at the aryepiglottic folds. These

pass through the hyothyroid membrane, and, reduced in number by coalescence, follow the superior laryngeal artery and cross the external carotid. They join the group of deep cervical glands situated on the common facial and internal jugular veins, or upon the thyroid gland. Some of the vessels occasionally pass *via* glands placed upon the intermediate tendon of the digastric, or at the lateral margin of the thyrohyoid muscle.

From the subglottic area, the vessels emerge in two sets. From the anterior subglottic area a few fine vessels pass through the conus elasticus (cricothyroid membrane) either in the midline, or laterally accompanying the inferior thyroid artery. The lymph from these eventually enters the deep cervical glands. The first vessels go to a pre-tracheal gland lying upon the conus, from which efferents may pass to a lower pre-tracheal gland and from the lower (when present), to a gland situated about the middle of the internal jugular vein, and to another pre-tracheal gland below the isthmus of the thyroid.

From the posterior subglottic area three to six vessels pass below the cricoid cartilage through the cricotracheal ligament. The vessels from this area accompany the recurrent laryngeal nerve and reach a chain of peritracheal glands which extend from the cricotracheal ligament along the posterior margin of the thyroid gland. In one case, Most found a vessel passing to the pre-tracheal gland upon the thyroid isthmus.

Thus intrinsic cancer remains for a long time confined to the inner surface of the organ, because of the scanty lymphatics and the restraining influence of the cartilages. The vessels do not enter these cartilages but are directed by them through the intercartilaginous membranes, thus there is slow absorption. When lymphatic drainage does take up the new growth, it follows certain lines, invades definite nodes, and, although it becomes extrinsic, there is still great good to be expected from the more radical operations.

Apart from the influence of the lymphatics, it is held by some that intrinsic cancer of the larynx is essentially a slow growing neoplasm.

It is important, in order to obtain the best results, that an early and definite diagnosis be made, and this can be done only by one thoroughly skilled in the use of the laryngeal mirror, and in the removal, by intralaryngeal methods, of portions of the growth for microscopic examination. When the growth is on the centre of the cord, as it is in more than one-half the intrinsic cases, the diagnosis is easy enough, but when it is under the cord, it can with difficulty be seen, its extent cannot be ascertained, and it is also difficult to remove a satis-

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factory piece for examination. It is then probably better to do a thyrotomy, remove the growth, and afterward make certain of a diagnosis, than to wait until the case has become extralaryngeal. In my cases, diagnoses were all made by Drs. Coakley and Chisholm, the former taking specimens for examination in each case.

### TECHNIC OF THE OPERATION

Many operators advise local anæsthesia. In one of the cases reported herewith, it was utilized for the preliminary tracheotomy, further operation being continued under chloroform administered through the tracheal cannula, in the other two, chloroform was administered from the outset. One of the advantages of local anæsthesia is that during the operation the sensibility of the larynx is in some degree obtunded, reflex acts of coughing are lessened, and, following the operation, the conduction of pain to the central nervous system is controlled, a point worthy of consideration, since the shock of handling laryngeal tissues, particularly those above the vocal cord, is great. However, to have the sensibilities too much blunted is never an advantage, because of the danger of an aspiration pneumonia, one of the most frequent and serious complications following laryngeal operations. Even when general anæsthesia has been used, it is easy to spray or swab the larynx or pharynx with a four per cent cocaine-adrenalin solution to prevent the reflex acts of coughing and vomiting which so disturb the conduct of the operation. This can easily be done in general anæsthesia after the thyroid has been opened, is not likely to be carried too far, and should permit the return of sensibility as soon as bleeding has been controlled, or as soon as the thyroid cartilage has been closed, until which time the patient should be kept with the head low to prevent aspiration into the lung.

Some operators prefer general anæsthesia, using chloroform, particularly in elderly people where it is feared to raise the blood-pressure, and on account of the lesser bleeding. In neurotic people there is no more objection to general anæsthesia than in any other condition. Besides, the presence of the tracheal tube allows one to tampon above the tube and thus prevent the entrance of blood into the lungs in a more effective way than can be done under local anæsthesia.

*Tracheotomy* should be performed as a preliminary, either several days preceding—thus making it a two-session operation—or immediately prior to the operation on the larynx. If the tracheotomy is performed some days in advance of the laryngeal operation, the mucous membrane has had time to adjust itself to the altered conditions under

which it receives the air, there is less coughing, and, in addition, the patient is able to swallow better and earlier following the operation. On the other hand, if the patient is phlegmatic, indisposed to brook the delay, or in fairly good condition, the tracheotomy can be performed at the time of the operation as well as it is in the Gluck method of complete removal. It is doubtful indeed if the infliction of the two operations at once is much if any greater than that of a tracheotomy alone.

The location of the tracheotomy should be low, but it will depend on the length of the neck, the depth of the soft tissues, and the location of the isthmus of the thyroid. One skin incision, as a rule, is sufficient for both operations, but it is conceivable that in a very long slender neck there might be two, one for a low tracheotomy and one for the operation proper. In all my cases the incision for the operation served also for the tracheotomy.

One should be prepared with tracheal tubes of different sizes and lengths. One of these should be long and flexible, and the Hahn or sponge-covered tube and the Trendelenburg tampon cannula should both be at hand, although neither may be necessary.

Some do not perform tracheotomy but keep a cannula through the cricothyroid ligament for some days after operation.

The next step is to split the thyroid cartilage in the angle between its two laminae, *i e*, in or near the median line, so as to protect the anterior insertions of the vocal folds, and this is by no means as easy as it would appear. This cartilage with the cricoid begins to ossify soon after the twentieth year, and in elderly people, the age at which cancers occur, it is often completely turned into bone, requiring a very strong sharp instrument to sever it. Scissors are recommended by most surgeons, but, as a rule, will be found totally inadequate, and very strong bone cutting shears or forceps will be necessary. The difficulty in the way of using any strong instrument is in introducing a blade, which must be large in order to be effective, through the cricothyroid membrane, without pushing off the lining mucosa and thus detaching the anterior end of the sound vocal cords even if the cord is spared at the time of operation, its attachment may be endangered through subsequent necrosis. In one case reported herewith, this accident happened—the anterior end of the opposite cord was stripped to some extent, was replaced by a stitch, and for a long time afterward showed in the laryngeal mirror as a beginning invasion. The laryngologist who had the case under observation suspected it of being a recurrence until this circumstance was recalled, and this, coupled with the fact that there

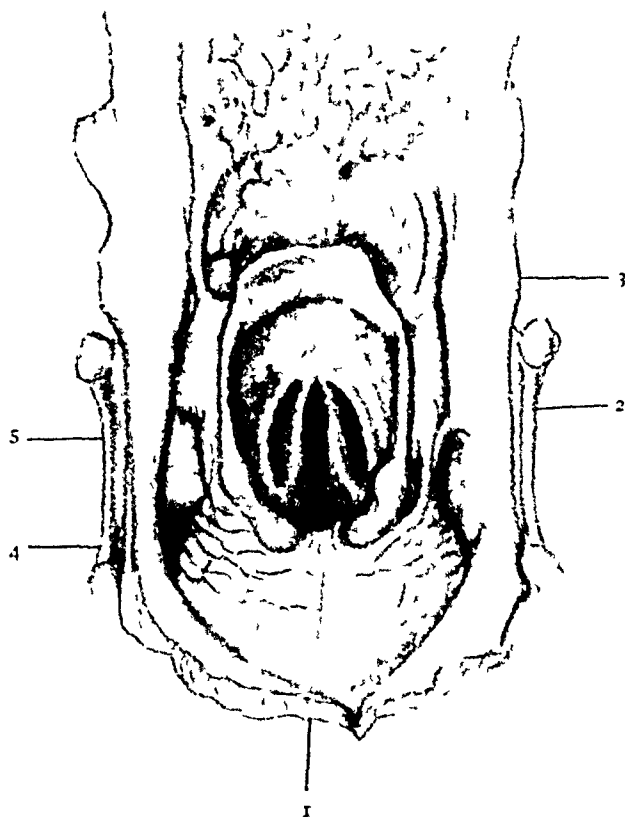


FIG. 1 —Extrinsic cancer is located at 1 interarytenoid space, 2 aryteno epiglottic folds, 3 epiglottis, 4 pyriform fossa. Intrinsic cancer is located at 5 vocal fold is somewhere below that level. (After Cunningham)



FIG. 2 —Showing network of lymphatics in interior of larynx (see text) (After Most)

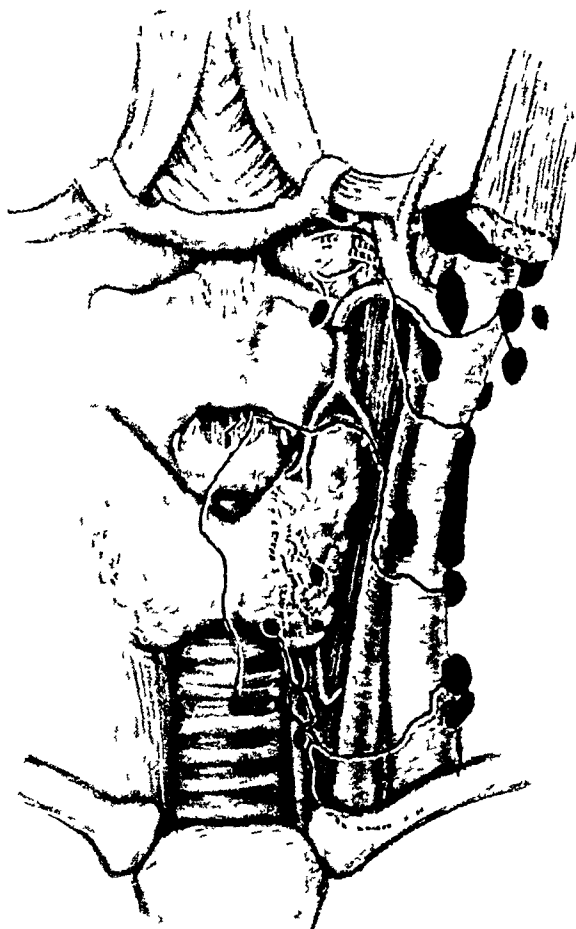
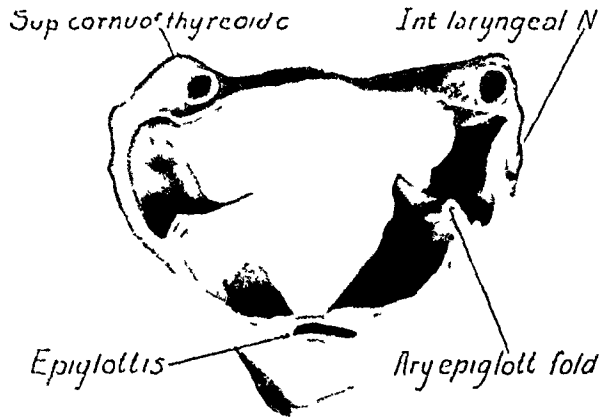


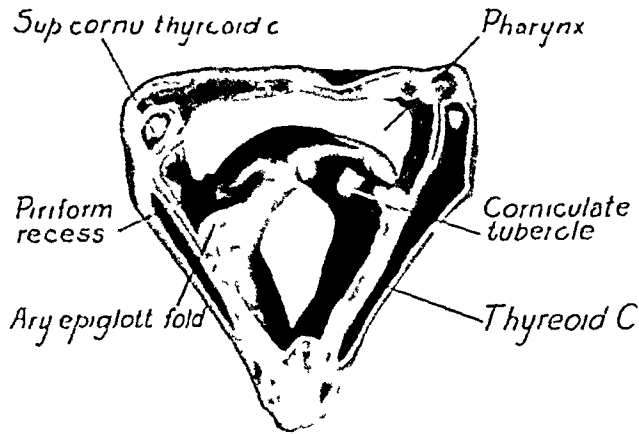
FIG 3 --Showing exit of lymph vessels from larynx and the nodes into which they empty  
(Adapted from Keen's Surgery after Most)

FIG 4



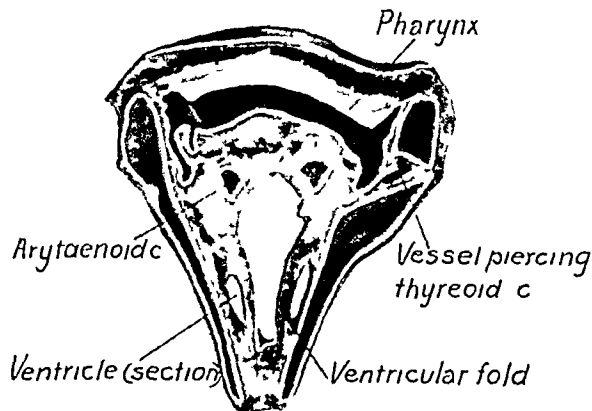
— 1 DISC 5-6C —

FIG 5



— 2. GC VERT —

FIG 6

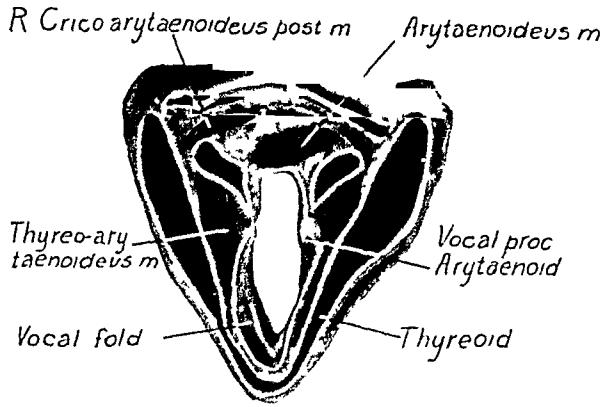


— 3. DISC 6-7C —

FIGS 4-9 —(Original) Transverse sections of larynx at different levels. They indicate the depths to which dissections can be carried in dissecting away the vocal cord. Figs 6, 7 and 8 are particularly useful indicating where the periosteal elevator and where curved scissors will best serve the operator. For further description see text.

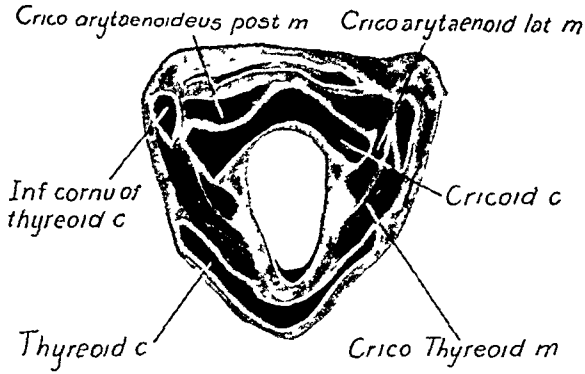


FIG 7



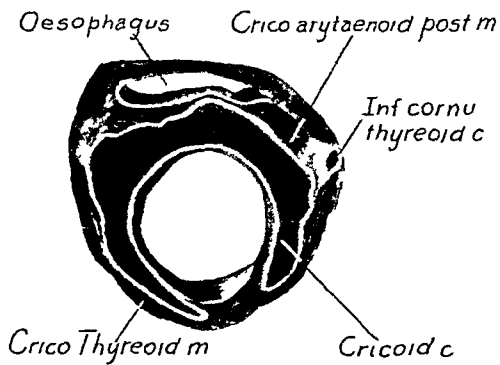
— 4 7 C VERT —

FIG 8



— 5 DISC 7C-1TH —

FIG 9



— 6. 1TH VERT —

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was no increase in size, led to the correct conclusion that it was not an extension of the growth

As one splits upward there is danger of wounding the epiglottis, and, remembering the earlier teaching that the epiglottis closes down over the upper aperture of the larynx during deglutition, it was disturbing to find, in one case, a large rent in the central tendon of this structure. Later teachings, however, are to the effect that the epiglottis is not of great importance in the act of deglutition and can be removed without interfering, in any great degree at least, with the passage of food

The thyroid having been opened (partial laryngofissure), it is now necessary to tampon the larynx above the cannula and also the pharynx to prevent soiling from the mouth or the œsophagus. Prior to this, it is necessary, if general anæsthesia has been used, to swab the larynx carefully with cocaine-adrenalin solution, as already indicated. If a pack is carried into the œsophagus, it not only prevents soiling but helps to locate the septum between larynx and pharynx.

Sometimes the room acquired by opening and spreading the thyroid is insufficient. It will depend on the angle at which the two laminæ of the thyroid meet. In the adult male this angle is about ninety degrees, in the female, about one hundred and twenty degrees, which means that in the latter it will be more difficult to expose the side walls. If insufficient, it may be necessary to cut the cricoid anterior arch (thyreocricotomy or total laryngofissure) and, although it is best not to do this, no great harm follows the manoeuvre.

After the interior of the larynx has been thus exposed so that the growth can be seen in all directions, it should be completely outlined by a knife, cutting down to the cartilage about one centimetre beyond the edge of the growth, then the diseased tissues should be taken away with a sharp periosteal elevator and short strong scissors markedly curved on the flat.

To determine how deeply one should go I have had some frozen transverse sections made (Figs 4, 5, 6, 7, 8 and 9). By reference to these, it will be seen that at the front and sides the tissues can be peeled cleanly from the inner surface of the thyroid cartilage, in the lower posterior part from the inner surface of the cricoid ring, that is, the dissection should be subchondral. Higher, at the level of the arytenoids, it is necessary to exercise care. If the growth is limited to the centre of the cord, it will only be necessary to cut the posterior end away from the vocal process of the arytenoid. If it extends further back, involving the vocal process, a part or whole of the arytenoid on that side should be

taken away When the arytenoid is involved, or when the growth crosses the posterior commissure involving the interarytenoid space, the case is not suitable for removal by thyrotomy, but a partial or complete laryngectomy should be performed, a condition for which one should always be prepared beforehand The lateral muscles which rest under the thyroid on the conus elasticus, particularly the thyro-arytenoid and the conus elasticus itself, will be sacrificed in this dissection

Control of the hemorrhage, as a rule, is not difficult, and bleeding is usually very much restricted through the use of cocaine and adrenalin Vessels should be tied or crushed, and sometimes, when a vessel perforates the cartilage, it is difficult to do either, and then it may be necessary to use the cautery, which can be utilized only when local anæsthesia or chloroform has been employed If absolutely necessary, one may control the bleeding by tamponing the cavity of the larynx, but most authors advise against this, regarding prompt closing as an important part of the operation

Closing is effected by two or three stitches in the perichondrium and soft tissues, or, if the cartilage is not ossified, the sutures may be made to pass through the cut edges In ossified cartilage, there is no need to take this precaution Drainage need not be employed, as a rule, for the wound is very superficial An attempt to close the defect in the mucous membrane as far as possible is recommended by some

The after-treatment is to keep the patient with head low until after consciousness has returned, then in the semi-upright posture in a room in which there is plenty of moisture in the air The tube can be removed in twenty-four or forty-eight hours, if no œdema obstructing the pharynx is present, which may be determined by laryngeal examination, or by taking the tube out and testing it, standing ready to replace it at a moment's notice The patient should be gotten up promptly, as a rule on the second or third day Feeding is a difficult problem, because the wounded larynx does not draw up well under the backward protruding tongue during efforts of deglutition One of my cases, the younger, who was more agile, was able, by putting his head lower than the rest of his body, to drink milk much as it is taken by a dog or cat, when, to do so in the ordinary posture, caused distressing strangulation It is possible that a preliminary tracheotomy might permit the patient to take food earlier for the same reason that respiration is more easily carried on When normal acts of swallowing cannot be performed, it may be necessary to feed through the nasal tube

Necrosis of the edge of the cut cartilage often follows the laceration of tissues, as they are very poorly nourished One of my cases kept

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on for several months discharging through a small sinus, doing the patient more mental than physical harm. On any account, however, the sooner such a process is over, the better.

The functional results are excellent. The cases I have done talk very well. As to recurrence, in two of them the prognosis is certainly favorable, one having already gone over three years, another nearly that length of time. In addition, I have two other cases, five in all, operated on long ago from which I heard some years later but have recently had no communication.

*Conclusion*—Laryngofissure is applicable to over one-third of all cases of laryngeal cancer. It is exclusively adapted to endolaryngeal cancer in its incipient stages. A circumscribed movable tumor near the centre of one vocal cord represents the most favorable case for laryngofissure. The operation is sometimes extended to cancer still movable but which has attacked the anterior commissure, the ventricle or the subglottic space. Laryngofissure is absolutely contra-indicated in all cases in which the arytenoid cartilage and the interarytenoid fold are involved, also in other extrinsic cancer. It is not often enough performed and is sometimes attempted too late. Its extent should be absolutely determined beforehand, otherwise one should be prepared for a semi or complete laryngectomy. The mortality is small—0.2 per cent. Speech is always possible, often satisfactory.

CASE I—W. R. M., insurance broker, aged sixty-four years. Patient always has had a sensitive throat and has had almost constant treatment. Because of increasing hoarseness, he consulted Dr. Stewart, who referred him to Dr. Chisholm in October, 1911. In December, 1911, two specimens were removed by Dr. Coakley for examination. Second specimen was suggestive of malignancy.

*Operation* (January 27, 1912)—The patient had a short neck. The incision was made from the hyoid bone to episternal notch. The isthmus of the thyroid was in the way and was severed between ligatures. A tracheotomy tube was inserted. The thyroid cartilage was split in the median line and the cricoid also to increase exposure. The left vocal cord was trimmed out entirely and its base cauterized. The anterior end of the right cord was also taken away. The mucous membrane in the vicinity of the anterior commissure was also removed.

*Pathological Report*—Specimen consists of a greatly thickened vocal cord and a small portion of tissue removed from the wall of the larynx.

The vocal cord presents near its centre an irregularly outlined indurated elevation, the surface of which presents several small crypts.

## GEORGE DAVID STEWART

Microscopical examination of sections made directly through this area reveals the histology of an epithelioma

Microscopical examination of the small particle of tissue removed from the wall of the larynx fails to reveal evidence of secondary deposits

Present condition patient talks fairly and feels better than for a long time He states that a feeling of stiffness in the throat which has existed for a long time prior to operation has disappeared

CASE II—I J, physician, aged fifty-two years

*Family History*—Striking history of malignancy on paternal side, father, one uncle, two aunts, and a cousin having had cancer A maternal aunt also suffered from the same disease

Hoarseness began in 1907-1908 This consisted of a slight huskiness which increased gradually until 1910, when he had almost complete loss of voice He received no treatment until 1910 Patient then went to a specialist who made a diagnosis of laryngitis with some cedema of vocal cords He took treatments occasionally until November 1, 1912, when he consulted Dr E H Griffin, who made a diagnosis of epithelioma Was also seen by Drs Chisholm, Coakley and Bosworth, who confirmed the above diagnosis Dr Coakley removed a specimen which disclosed malignancy While the diagnosis was being determined, potassium iodide was given in forty-grain doses three times a day for four weeks, in spite of a negative Wassermann reaction No improvement followed

*Operation* (December 31, 1912, by Dr Stewart)—Tracheotomy under local anæsthesia followed by general anæsthesia through tube, and right vocal cord with tumor removed The patient had difficulty in swallowing fluids for some time and was compelled to drink with neck lower than chest Tracheotomy tube was removed at end of fourth week

About March 15, 1913, he began to have difficulty in breathing again and returned to New York Because of increasing difficulty in breathing, a tracheotomy tube was inserted about April 15, 1913 Examination of larynx disclosed almost complete stenosis Examination of specimen removed through tracheotomy tube showed the histology of granulation tissue

In July, 1913, because of the stenosis, the larynx having filled with either granulation tissue or new growth, the patient was referred to Dr Howard Kelly of Baltimore, who gave two intralaryngeal and two extralaryngeal treatments with radium from July 18 to 27, 1913 After the first treatment there was a profuse discharge from throat, and on July 27 he was able to get air through larynx On July 28, respiration through larynx was

## INTRINSIC CANCER OF THE LARYNX

fairly free and he has been breathing through larynx ever since. He has taken radium treatments on the following dates: September 18 and 19 1913, intralaryngeal treatment for two hours and extralaryngeal treatment with six hundred and fifty milligrammes for fourteen hours, the last treatment being January 11, 1914, with eight hundred and two milligrammes.

Though he wears a tracheotomy tube, it has been plugged since the fall of 1913. Patient has seen Dr. Kelly twice since, but has received no further treatment.

Present condition. Voice hoarse, breathing free.

CASE III — R. K., aged seventy years, married, German broker.

*Family History* — Negative.

*Past Personal History* — Patient has been a singer during entire life. Exercised voice daily. For many years was broker on floor of Stock Exchange, where voice was subjected to prolonged strains. Has smoked 2 or 3 cigars daily.

In 1908 he noticed a roughness in voice when delivering a short address. On one occasion during the same year after singing a difficult work, he experienced a sharp, knife-like pain in the larynx. Because of increasing roughness in voice, he consulted a throat specialist, who treated him for about a year and, in May, 1910, removed from the right vocal cord a papilloma. Following this he resumed his singing with no discomfort and greater success. After six months he became aware that his throat was not normal and gave up singing. The roughness in the voice reappeared and a specimen removed about November 1, 1914, proved to be malignant. He suffered no pain, no bleeding, no coughing, no difficulty in breathing. His only symptom was hoarseness.

*Operation* (November 11, 1914) — Tracheotomy under chloroform preceded by morphine. Anæsthesia continued through tracheotomy tube. Thyroid opened. Mass very distinct, involving and below true vocal cord on right, slightly across anterior commissure. Portion on left removed first, then that on right was trimmed off, dissecting it with curved scissors and a small periosteal elevator. Cartilage and upper part of wound closed. Tracheotomy tube left in.

*Remarks* — Anæsthesia was very satisfactory.

*Pathological Report* — Specimen consists of a small piece of tissue taken from surface of larynx below vocal cords. Microscopically, sections show a typical downward growth of squamous epithelium with "pearl formation." Diagnosis. Epithelioma.

Examined by Dr. Coakley May 7, 1915, who reported no evidence of a recurrence. At present writing, exactly one year after date of operation, there is no return of growth.

## SUPPURATIVE PERICARDITIS

By GOODRICH B RHODES, M D

OF CINCINNATI, OHIO

(From the Surgical Department of the Cincinnati General Hospital)

IN 1897 John B Roberts tabulated 35 cases of purulent pericarditis in which operative interference other than paracentesis had been practised. This represented the total number of cases up to that date. In 1900 C B Porter collected 16 additional cases. He was followed, in 1909, by Ellsworth Eliot, Jr, who added 22 cases, bringing the total number to 73. In all of these reports the literature has been admirably collected and brought up to date, therefore this paper will concern itself principally with the cases and literature subsequent to Eliot's article. To these 73 cases it is the purpose of this article to add 13 cases, 11 collected from the literature, with 2 additional cases from the Cincinnati General Hospital.

In 1649 Riolanus advocated tapping the pericardial sac for effusion, and his therapeutic suggestion was reiterated fully one hundred years later by Senac, but unfortunately there exists no documentary proof that either of them put their conceptions into actual operative practice. Corvisart, in 1806, denounced the proposed operation, claiming it to be dangerous and unjustifiable. To Romero of Barcelona belongs the credit of first performing paracentesis. In 1819 he performed the operation three times, twice successfully. In 1854 Trousseau reported several successful cases and Clifford Allbutt introduced the operation into England in 1866.

Roberts credits Hilsmann (1844) with the first incision and drainage of the sac, but v Walzel cites Romero as being the first to drain the sac by intercostal incision, but gives no date, and I have been unable to verify this statement. The first rib resection, combined with incision and drainage of the pericardium, was performed by Rosenstein, of Leyden, in 1881. Kocher states that resection and trephining of the sternum to afford access to the pericardium was practised by Riolanus in 1653.

The incidence of suppurative pericarditis varies somewhat with the different observers. It is comparatively rare in children, approximately two-thirds of the cases occurring in adults. The autopsy records of the Harvard Medical School from 1896-1911, as compiled by Barkan

## SUPPURATIVE PERICARDITIS

and Lucas, show 363 cases of pericarditis in a total number of 3,248 autopsies. Of these 363 cases 6 cases of suppurative pericarditis were recorded, or 1.6 per cent. Cowan gives figures based on 324 cases of all types of pericarditis, 24 of which were suppurative, or 7.4 per cent. In infants by far the greatest number of cases occur during acute pulmonary infections, empyema or pleurisy, while in older children it occurs oftenest in the course of an acute endocarditis. Primary pericarditis in children is rare, the secondary type showing the major number of cases, of which rheumatic affections claim from 40 to 60 per cent (MacLeod, Weill).

The bacteriology of the exudate exhibits a wide range. Staphylococci, streptococci, Fraenkel's diplococcus, *B. pyocyaneus*, *B. tuberculosis*, *B. coli communis*, influenza, rarely *B. lactis aerogenes*, and *B. proteus vulgaris*, and very frequently the pneumococcus have been found, while some cases report a sterile exudate. The pneumococcus is preëminently the organism responsible for the condition in infants, while in adults and older children the streptococci and staphylococci are present in the majority of cases. In the complete series of 85 cases the infecting organism is reported in but 21, the pneumococcus was found in 9 cases, staphylococci in four, streptococci in three, a mixed infection of staphylococci and streptococci in two, the colon bacillus in one, the bacillus *pyocyaneus* in one, and a "double coccus" in one.

The pathology and symptomatology present very interesting features. There are two distinct sinuses in the pericardial sac, one, the larger, lying to the right of the large vessels at the base of the heart, and the other, a smaller one, situated along the right posterior edge of the sac, corresponding to the sternal angle of the fifth intercostal space. In beginning exudates, these sinuses fill first, and hold roughly 200 c.c. Even this amount of fluid can push the heart forward against the sternum, as is seen in Kiliani's case. A small amount of pus in the pericardium can give no symptoms, aside from its constitutional evidences and the increased leucocyte count, and can be diagnosed with certainty only by the X-ray. This constitutes the first stage of the lesion, and one, unfortunately, very seldom diagnosed. A second stage is instituted with the increase of the exudate up to the limits of elasticity of the sac. This stage is the ordinarily observed stage of physical signs. When, however, the limit of elasticity of the sac is overstepped by the amount of exudate, a third stage is seen, to which Rehn has given the name of Herzdruck. Rose calls it Herztamponade. It is produced by the intrapericardial pressure exceeding the intra-auricular pressure. The symptoms were shown splendidly in the



subacute form before operation in my case, and after operation when interference with the return flow during irrigation caused it in an alarmingly rapid manner. This latter accident occurred also in the cases of Blake and Parker.

In the slowly developing form of Herzdruck the symptoms are very striking. The patient is cyanotic, evidently in great respiratory embarrassment, even orthopneic in extreme cases. Pain in the left arm is a common symptom. Precordial pain, increased by expiration, with a feeling of oppression in the chest. Œdema of the upper thorax and one or both arms is often seen, aside from thrombosis. Some cases have shown, as did mine, slight rigidity and pain in the upper abdomen, usually on the left side. The veins of the neck are distended and the pulse is rapid and small. A very prominent symptom in my patient, as in the cases of v. Eiselsberg and Harrigan, in which the intrapericardial tension was high, was great irregularity of the pulse. In very few of the cases is this found, and it would seem to me to be more dependent on great distention of the sac than on inflammatory irritation of the pericardium, as has been claimed by Hertler. My reason for this view is the instantaneous return of the pulse to normal frequency on opening the pericardium in my case and the slower return in Harrigan's case after removal to the ward. Of course the mere withdrawal of fluid will not immediately relieve an inflammatory irritation, and if arrhythmia is to be explained as a result of pericardial inflammation, why do not the majority of cases of pericarditis show it?

The increase in the exudate pushes the heart forward, so that in the greater number of cases the heart is found to occupy a position directly against the anterior chest wall. Rehn, Brentano, Curschmann, and Schaposchnikoff hold that this is always the case, while Eichel contends that it is not always in contact, and even may occupy a posterior position. A study of the reported cases in which the position of the heart is mentioned shows that in four cases the heart is said to be anteriorly placed, and in two cases, those of Sibley (operated on by Mr. Lane) and Harrigan, it lay deep in the thorax, while Eichel reports that all his cases, as did mine, had fluid between the heart and anterior pericardium. However, the exceptions must not blind our eyes to the important fact that the heart is usually held anteriorly by the exudate.

Among the rarer symptoms Blechmann has called attention to the genu-pectoral position assumed by some patients. Hertz claims this to be pathognomonic, and of course due to the effort to relieve the large vessels of the backward pressure of the heart and exudate.

In the X-ray we possess a most valuable aid in diagnosis, especially

## SUPPURATIVE PERICARDITIS

in the early cases, and in children. In adults care must be exercised to avoid error in diagnosis, for in some of the early cases the radiographs have closely simulated those of aneurism of the first portion of the aorta. Purulent mediastinitis also presents a similar picture. No obscure chest condition presenting a high leucocyte count should be allowed to escape the X-ray, for in that direction may lie our sole opportunity to make an early diagnosis, while the fluid is still in the pericardial sinuses.

The combination of these special symptoms with the well-known physical signs of fluid in the pericardium and a high leucocytosis is sufficient to make the diagnosis. The leucocyte count runs high, 20,000 to 38,000, and it is well to remember that an associated empyema or pneumonia may complicate both the leucocytosis and the physical signs. The liver is very often pushed downward, especially in large effusions, sometimes a hand's breadth below the free margin of the ribs. In one case the diagnosis of liver abscess was entertained.

Aspiration of the pericardium, for treatment or diagnosis, must be most emphatically condemned. Fevrier has collected 9 cases from the literature which were treated solely by aspiration with a mortality of 100 per cent, not a very encouraging percentage, even when compared with the high percentage following operation. I am not aware of a single case which has been cured by simple aspiration. For diagnostic purposes many important facts contra-indicate its employment. It is usually superfluous, if a careful study of the case has been made, and due attention paid to the X-ray, leucocytosis and temperature chart. It can be of positive danger, as it is impossible to be certain where the pleural reflexion lies in any given case, and there is no guarantee that the needle will not pass through normal pleura into the pus cavity, allowing the pus under tension to follow the withdrawal of the needle. The accompanying drawings, made for me under the direction of Prof. Knowler of the Anatomical Department of the University, were prepared accurately from cadavers, showing the variations in the lines of reflexion of the pleura from the chest wall and its relation to the pericardium. A study of these will show how frequently the pleura will be penetrated if we introduce a needle in accordance with the usually accepted sites for aspirating the pericardium. It has been stated that in high grade effusions the parietal pleura is stripped back by the distended pericardium, making paracentesis a safe procedure. Although this may be true in some cases it most certainly does not always occur, as a large number of the reported cases will show. It has been my fortune to open the distended pericardium twice, once for hemorrhage

from stab wound, and once for pus, and in both cases the pleural reflexion had to be pushed aside to allow entrance into the pericardial sac

Adhesions binding the heart to the anterior chest wall may render puncture of the heart unavoidable. It must not be forgotten that in the larger proportion of cases the heart is forced against the chest wall by the fluid, in a position easily reached by the needle. Paget's case died from hemorrhage from the right ventricle following paracentesis, and in Jacob's case adhesions were found post mortem. Venus has collected seven cases of puncture of the heart during aspiration, in one of which sudden death occurred.

Furthermore, there is no certainty that the needle will reveal pus, thus blinding our eyes to the true state of affairs. As we have seen the beginning exudate is found in the accessory sinuses, behind the heart, out of reach of the needle. Kiliani's case showed this beautifully. The needle may become plugged, or the exudate too viscid or thick to flow through it. A consideration of these facts should make us less ready to plunge a needle into every suspected pericardial effusion. A resection of one costal cartilage followed by pericardiotomy, or aspiration of the pericardium under direct inspection is not a serious procedure, and should be the method of choice.

The prognosis of these cases presents variations due to differing circumstances. Cases unoperated or treated by aspiration alone can be said to have no chance, while the outlook for the cases submitted to operation affords hope of recovery if operative interference is carried out early, if no complications are present, or if present are detected early and remedied. I refer especially to the development or coincidence of pleural empyema. A study of the causes of death in the fatal cases shows that in by far the greater number recovery was not to be expected while such antagonists as pyæmia, sepsis, and pneumonia are still unconquered. Of the 86 cases 45 recovered and 41 died, a percentage of 52.3 per cent recoveries as against 47.7 per cent deaths.

*Treatment*—Since the last review of the subject Mintz' method of operative attack is the only addition to the already numerous avenues of approach to the pericardium. This method was proposed by him in 1903, but was first used on the living patient since the last review. As described by him it consists in an incision along the under border of the seventh costal cartilage. A skin and cartilage flap is now made, and opened from above downward. Access is now permissible to the extraperitoneal space in which the pericardium can be opened without danger of injury to the pleura.

All the described methods have as their object the incision and

thorough drainage of the pericardium. Certain lessons can be learned by study of the case reports. The exudate should not be allowed to escape too rapidly from the pericardium, for too rapid lowering of the intrapericardial pressure may result in sudden "still stand" of the heart, as occurred in Harrigan's case. It might even be advisable to aspirate the pericardium before incising it. If no exudate is observed anteriorly examine behind the heart, as it may be pocketed there. The sinuses must be thoroughly explored.

The question of drainage and irrigation is of the greatest importance. Free drainage must be maintained, and certain obstacles stand in our way. The continuous action of the heart tends to force out the softer drainage materials, such as rubber tissue, while the experience of Tartarinow (quoted by Kolb) shows the danger of the rubber tube, which caused necrosis of the heart wall by pressure. V. Eiselsberg advocates stitching the pericardial sac to the muscle layer, while Gussenbauer sews it to the skin margin. This when possible should be done, as the incision tends to close very rapidly, but where there is extensive œdema of the soft tissues, whether from anterior mediastinitis or from Herzdruck, as in Eliot's case, and in my own, it is impossible. Drainage of some description must be used, as a considerable portion of the fatal cases show no provision was made for permanent drainage. Fear of necrosis in my case led me to discard the rubber tube in favor of rubber tissue, which was passed at each dressing into both sinuses of the sac with dressing forceps after irrigating the sac with salt solution. This method of drainage proved amply sufficient, as the post-mortem showed, although the daily irrigation and replacing of the drains was very painful.

I am indebted to Dr. C. E. Caldwell, of the South Surgical Division of the Cincinnati General Hospital, for the privilege of operating on this case. My thanks are also due to Dr. Ransohoff for the permission to report his case from his service in the General Hospital, and to Prof. Knowler for his assistance in the anatomical work.

**AUTHOR'S CASE**—C. C., German cook, aged twenty-six years, was admitted to the Cincinnati General Hospital on the medical service of Drs. Grewe and Fihe, July 25, 1914, complaining of pain in the side on deep inspiration. This began suddenly July 12, after sleeping with no covering. He woke up suddenly and could not get his breath. Headache.

*Examination*—Pale, obese adult. Temperature 102.8°, pulse 116, respirations 36. Heart and lungs negative. Pharynx congested. Abdomen, no dulness, but sensitive to pressure in epigastrium. Otherwise normal. Treatment: Catharsis, rest in bed.

FIG 1

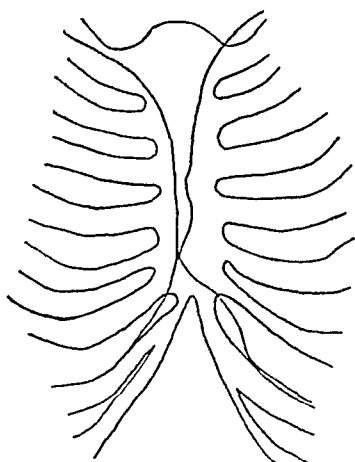


FIG 2

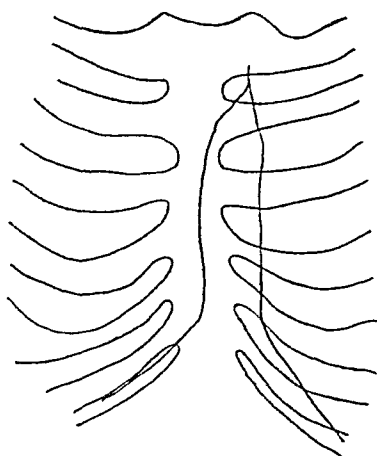


FIG 3

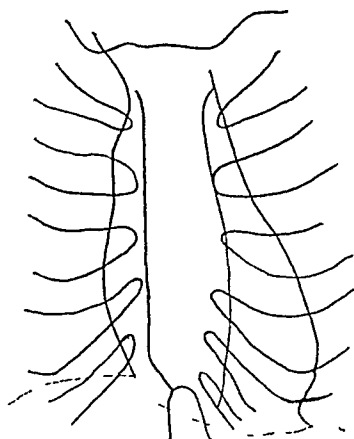


FIG 4

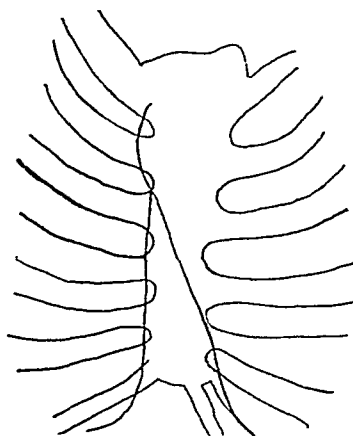


FIG 5

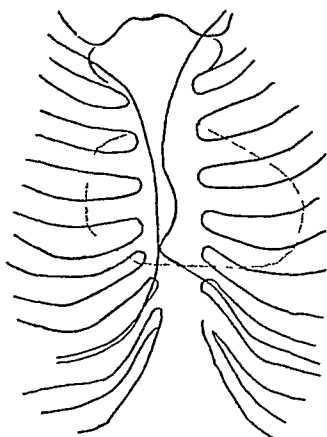
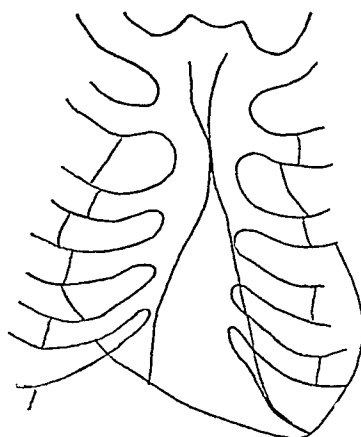


FIG 6



FIGS 1-6 —Pleural reflexion in relation to anterior chest wall      Figs 3 5 and 6 also show heart outline



FIG. 7 —Radiogram of thorax in author's case



## SUPPURATIVE PERICARDITIS

July 27 Sore throat Alkaline irrigation used

July 28 Urine showed albumen and casts Blood pressure 160 mm

August 2 Marked arrhythmia of pulse Dusky cyanosis with pain referred to upper abdomen

August 3 Same condition, but pain now is felt under sternum Sensation of gripping around the heart Dyspnoea, not relieved by amyl nitrite inhalation Leucocyte count 38,000, 84 per cent polymorphonuclears

August 8 Friction sound heard over pericardium Moderate dulness in left lower axilla and back Tenderness is greater in the epigastrium and a rounded mass the size of a baseball can be indistinctly felt Rigidity of the right rectus overlying area of dulness on percussion Patient seen by author, who placed the lesion in the thorax rather than in the abdomen, and advised X-ray

August 10 Œdema of wall of right chest and arm, not of angioneurotic character Blood-pressure 140-145 mm

August 11 X-ray of chest shows an enlarged heart shadow (see Fig 7) Paracentesis in fifth interspace, three fingers' breadth from sternal margin Pus withdrawn Aspiration of right pleura, eighth interspace, below angle of scapula gave 24 ounces of slightly turbid fluid, straw colored Transferred to South Surgical Division

*Operation* (August 11, 1914) —Dr Rhodes Operation started in sitting position under local anæsthesia After skin incision ether substituted in recumbent position Hockey-stick incision, starting from third costal at left sternal margin, downward and curving outward along the seventh rib Great œdema of tissues Fourth and fifth costal cartilages and portions of ribs resected subperiosteally Anterior mediastinum greatly infiltrated with œdema Internal mammary artery not encountered Pleural reflexion seen about 1 cm from left sternal border, evidently not pushed to left by exudate, and must have been perforated by the needle in aspirating Pericardium was now opened, and a large amount of greenish-yellow pus evacuated A sphygmomanometer had been adjusted to the arm before incising the sac and the blood-pressure registered 150 mm The pulse was exceedingly irregular *Immediately following the escape of about one quart of pus the pulse became regular*, while the blood-pressure more slowly sank to 125 mm The heart was noticed to lie about 1 cm from the pericardium in front, so that quite a definite layer of pus separated it from the pericardium The pericardium was now irrigated with salt solution Two large drains of rolled rubber tissue were passed into each pericardial sinus, and other



strips passed between. It was found impossible to sew the pericardium to the skin because of the thickness of the intervening tissues, due to oedema and obesity of the patient.

August 12 Patient in good condition. Wound draining well. Much more comfortable. Cyanosis and dyspnoea have disappeared. Irrigation of pericardium with bichloride, 1-3000.

August 13 Pain in left elbow. Arm swollen and painful. Thrombosis of subclavian vein suspected. Irrigation of sac.

August 14 Severe pain in abdomen and chest. Daily irrigation of pericardial sac. This was done with a catheter introduced into the pericardial sinuses. On this occasion the outlet to the irrigating fluid became clogged in some manner, while the fluid still flowed into the sac under a pressure of about  $2\frac{1}{2}$ -3 feet elevation. The patient suddenly became cyanotic, in extreme dyspnoea, then gave one or two convulsive movements and became apparently lifeless. The catheter was rapidly pulled out, followed by a gush of irrigating fluid. Respiration began immediately and in three minutes the patient was as well as previously.

August 14-19 Condition about the same.

August 19 Signs of fluid in left chest. Patient weaker. Aspiration withdrew one litre of serosanguineous fluid. Patient delirious. Heart strong but general condition bad. Died 9 30 P M.

*Post-mortem Report*—Sex, male. Age twenty-six. Admitted July 25, 1914. Died August 19, 1914. Necropsy 15 hours after death. Staff Officers, Drs Grewe and Fihe. Pathologist, Dr Woolley.

*Clinical Diagnosis*—*Pyopericardium, pleurisy with effusion, nephritis, myocarditis*.

*Anatomical Diagnosis*—Acute fibrinous purulent pericarditis, acute vegetative mitral endocarditis, acute interstitial myocarditis, septic infarcts in lungs, spleen and kidneys, acute fibrinous pleuritis and mediastinitis, acute splenitis and hepatitis, axillary and coronary venous and hepatic arterial thrombosis, fatty liver, general anæmia, Meckel's diverticulum, costotectomy.

*Microscopical Diagnosis*—Acute diffuse nephritis, septic infarcts and milary abscesses of liver, septic infarcts and milary abscess and softening of spleen, septic thrombi of splenic vessels, congestion, infarcts and milary abscesses of lung, suppurative pericarditis, septic thrombi subclavian artery.

*Necropsy*—The body of a heavy, well-built, powerful man of medium height. The pupils were normal, the general color of the skin a pale yellow, upon which was superimposed a slight lividity, most evident about the face and neck. The left arm was œdematous to the shoulder. There was a slight evidence in the odor of the body, of beginning post-mortem decomposition. Post-mortem lividity was only slight. Rigor mortis had almost disappeared. Just to the left of the median line of the thorax and over the area of normal cardiac dulness was the wound of an operation which had

## SUPPURATIVE PERICARDITIS

included a triangular costotectomy for the relief of a purulent pericarditis. The base of the operative area was covered with a yellowish-gray fibrinous mass. There was little evidence of reaction on the part of the tissue.

The body was opened in the usual way, and the sternum removed. The subcutaneous fat was well developed and thick. The omentum was in its normal position covering the appendix and was loaded with fat. The mesentery was likewise very adipose. The intestines and stomach were moderately distended with fat, but lay in their normal positions. The appendix was apparently normal. About two feet above the cæcum were the blunt triangular remains of the mesenteric-omphalic duct. The liver reached just below the costal margin. The mediastinal tissues were exceedingly œdematous, especially in the thymus area, at which place there seemed to be some incompletely fatty remnants of thymus. The lungs did not collapse, chiefly because of numerous pleuropericardiac adhesions.

The pleural cavities contained a slightly increased amount of a fibrin containing fluid, and the pleural surfaces chiefly over the lower lobe in the left, and the lower and middle lobes in the right, were covered with a thin layer of fibrin, beneath which the pleura was roughened and congested.

The lungs were both œdematous, especially so in the lower lobes, in which beside the increased fluid there were numerous areas of consolidation, mostly at the edges of the lobes, and mostly of a generally triangular shape. Section into these showed them to have a rather chocolate-grey color, though they were much darker than the adjacent pulmonary tissues, and paler than the red infarct, though they were moister than the white, and showed no well marked zone of demarcation. They were probably septic infarcts. Within the substance of the lungs were a number of small abscesses.

The heart was of about normal size, and was covered with a thick fibrinous exudate in the parietal pericardium. Beneath this exudate, congestion which involved the myocardium was well marked. The myocardium was pale and slightly (macroscopically) fatty. The valves with the exception of the mitral, were apparently healthy. Upon the mitral leaflets were two large (1 by 3 mm) beefy red vegetations, together with a number of minute ones. The aorta was smooth. In the vena cava there was found a reddish mass of thrombus which projected into the lumen in form of a concave plate (1 cm in diameter) with thin edges. This proved to be the proximal end of a thrombus which extended into the axillary vein and its branches. The left coronary vein was also thrombosed.

The liver was but little larger than normal, but was excessively pale and fatty. Upon its surface were seen a number of small dewdrop areas the size of miliary tubercles, situated just beneath the capsule and extending into the substance. A few similar areas were discovered in the parenchyma (miliary abscesses?). A number of thrombosed vessels apparently belonging to the hepatic system were discovered. The biliary vessels were patent. The gall-bladder was slightly congested, but otherwise healthy.

The pancreas was congested, but no other abnormality was noticed.

The stomach and intestines showed nothing remarkable when they were opened.

The spleen was enlarged, fairly firm, and with rounded edges and

smooth capsule At the lower pole was a pale area, somewhat swollen, and surrounded by a zone of extreme congestion Near it was a similar, though darker area Both were triangular On section the former proved to have all the characteristics of a white infarct, while the latter was similar in appearance to the pulmonary infarcts already described There were also, in the spleen, scattered groups of pale almost milary areas which were probably small abscesses

The kidneys were larger, pale and juicy The cortices were widened and both organs showed all the characteristics of an acute diffuse nephritis The glomeruli were congested, the cut edges of the organs curled outward and the capsules were readily stripped In the cortices and medullæ, chiefly in the former, were numerous small areas of suppuration surrounded by zones of congestion Some of these were spherical, others were linear In some instances such lines extended entirely across the cortex The pelves, ureters and bladder showed nothing abnormal

DR RANSOHOFF'S CASE—J P, 28 years old, single, colored laborer, was admitted to the Cincinnati General Hospital, January 10, 1913, complaining of pain on the right side, shortness of breath and cough He was placed on the medical service of Dr Mark A Brown

He had had measles ten years ago, chicken-pox and mumps when a child Rheumatism in 1905, confined to bed for two weeks Gonorrhœa at age of 22, syphilis at 23

About January 7, 1913, when working, he developed pain in right side, shortness of breath, cough with tenacious sputum and came to hospital for treatment

*Examination*—Well-developed negro Temperature 102.4°, pulse 104, respiration 24 Lips dry, tongue coated, teeth in bad condition Slight glandular enlargement in neck Chest normally developed, expansion limited on right side, apices dull Right lower lobe dull Crepitant and bronchial breathing Heart normal in outline and sound Abdomen rigid Liver and spleen not palpable Extremities normal except clubbing of fingers Urine normal

January 14 Patient complains of pain in right side, also pain in precordial region Pericardial friction rub heard Morphine gr  $\frac{1}{4}$ , ice-bag to precordium

January 15 Pain easier Rub still distinct

January 16 Rub can be heard at base only

January 31 Needle was put into chest, sixth interspace just beyond apex of heart and a quart of pus drawn off

February 5 Respiration increased in frequency, 32 per minute Above clavicle on left side a bulging is noticed, also a bulging on expiration in the second and third interspaces on left side At the end of inspiration the heart action can be seen to the right

## SUPPURATIVE PERICARDITIS

of the sternum Very little expansion noticed of chest on left side below Dilated veins seen on left side of chest

*Palpation*—Tactile and vocal fremitus present over entire right side anteriorly It is absent over lower posterior part It is present over upper part of left side

*Percussion*—Low pitched hyperresonance is heard over the right apex posteriorly High pitched resonance is heard over the left apex posteriorly Beginning at the spine of scapula on the left side going downward there is diminished resonance, soon becoming flat On the right side just above liver a small area of dullness is noted

A small area to the left and below the left nipple is hyperresonant Resonance is increased over right apex anteriorly, at the right side beginning at the second rib and going downward there is absence of resonance

*Auscultation*—Diminished and absent breath sounds over the entire left side, except in small area below and posterior to nipple Over right side there are roughened breath sounds at upper lobe anteriorly and posteriorly, and diminished breath sounds lower down

Aspirating needle introduced into fifth interspace in mid-axillary line on the left side Two ounces of pus withdrawn The aspirating needle introduced into fifth interspace 3 to right of sternal border withdrew  $\frac{1}{2}$  ounce

Marked œdema of left arm Radial pulse of left side could not be felt Left fingers cold Pus sent to laboratory Report by Dr W B Wherry Diplococci of staphylococcus form present No signs of *B. bulgaricus* Patient referred immediately to West Surgical Service, Dr Ransohoff

*Operation*—Dr Joseph Ransohoff One per cent cocaine local anæsthesia Incision 6–7 inches long, parallel to left border of sternum and costal margin of left ribs (Kocher) ending internal to nipple Periosteum of sixth rib injected with cocaine, stripped off, and 2 inches of rib resected, starting from  $\frac{1}{2}$  inch from sternum Pericardium punctured and pus drawn off Pericardium picked up with hæmostats and opened by a vertical incision, liberating about 3 pints of a fairly thick yellowish pus Pericardium stitched to anterior chest wall and gutta percha drain inserted Skin closed with silkworm-gut

Patient complained of a very little pain during operation Was given drink of whiskey while on table Returned to ward, pulse much stronger and better than before operation Immediately after operation the excessive dyspnoea disappeared, the radial pulse appeared, and the area of flatness on the chest became smaller.

## GOODRICH B RHODES

February 6 Dressings saturated with pus

February 7 Dressings again saturated Removed drain and inserted rubber tube

February 8 Irrigated pericardial sac, washing out a quantity of fibrous material

February 12 Discharge still profuse but more viscid Sputum examination shows no tubercular blood-cells

February 27 Washed out pericardium and injected liquid lacto bacilline Metchnikoff

February 28 Washed out pericardium and injected liquid lacto bacilline Metchnikoff daily

March 1 Discharge seems to be liquefying Amount is about same Smears of pus of February 17 show comparatively few bacteria left and they are all inside of polymorpholeucocytes Blood culture showed pure culture of staphylococcus albus

March 5 Patient died

*Postmortem Anatomical Diagnosis*—Purulent pericarditis, empyema (left pleural cavity), infarct of lung, fatty cirrhosis of liver, infarct of left kidney, thrombosis of left renal artery, congestion of lungs and kidneys, thrombosis of right internal jugular vein

*Chest*—Right lung showed congestion and an infarct in lower portion of middle lobe, pleura normal Left pleural cavity contained about a quart of greenish pus, and the lung was found compressed into upper part of pleural cavity It showed infarction and congestion

*Heart*—Pericardial sac was entirely obliterated except posteriorly, below and anteriorly where drainage had been established

*Abdomen*—Pancreas, spleen and alimentary canal normal

*Kidneys*—Left kidney showed a total infarction due to thrombosis of renal artery Right kidney was congested

### CASES COLLECTED FROM THE LITERATURE

CASE I—HARRIGAN Weak, anæmic child, eleven years old Trouble began one week ago with swelling in left thigh, no chill, slight elevation of evening temperature Admitted September 10, 1912, pulse rapid, weak and irregular, heart sounds weak and distant Temperature 100.4°, pulse 126, respirations 24 Liver, spleen and kidneys not palpable, abdomen moderately distended Dulness, bronchial breathing, increased fremitus and moist râles over left apex Dulness, increased fremitus, diminished voice and breath sounds over base of left lung

Left thigh swollen, red, tender, and deep fluctuation is present

Left pleura tapped 6 oz turbid fluid, containing pus cells and few Gram-negative staphylococci

September 11 Heart action much embarrassed Pericardium tapped 30 minims turbid serum No tubercular blood-cells Cytological count, polymorph-nuclears 49 per cent, large lymphocytes 33 per cent, small lymphocytes 78 per cent Culture plates were contaminated

## SUPPURATIVE PERICARDITIS

September 12 Area of cardiac dulness 11 cm to left of mid-sternal line, and increased to right of sternum Sounds muffled but regular

September 13 Subperiosteal abscess of left femur incised and drained Ether anaesthesia Cardiac and pleural condition became progressively worse for next few days Left pleura aspirated September 26 12 oz blood-stained fluid

September 28 Aspiration of pericardium through left fifth interspace, 1½ inches from sternal border Pus withdrawn and was ejected from pericardium with considerable pressure after trocar was withdrawn

*Operation* (Dr Harrigan) —Dorsal position Incision 4 inches long, beginning at left sternal border, passing obliquely downward and outward, crossing left costal cartilage at its centre, 1½ inches of left fifth rib and costal cartilage removed Left pleura accidentally opened when anterior mediastinum was opened Plugged with gauze

Pericardium about 2 inches from surface of chest and covered with semi-gelatinous material Pericardium incised 2 inches Large quantity of pus gushed out forcibly, spurting two feet high Culture showed staphylococci Heart was deeply placed, and was motionless No pulse was felt Could not determine whether heart was in systole or diastole Function resumed when gauze drain was forced into pericardium Duration of cessation of pulsation not timed Pulse rapid and strong Patient was removed from hospital by parents next day, and died four days later No postmortem

CASE II —v EISELSBERG (reported by v Walzel) Nine-year-old school boy Diphtheria and measles when five or six years old March 1, 1903, chill and fever, and evening temperature 38.5° Left-sided pneumonia diagnosed Four days later extreme dyspnoea, cyanosis, and feeling of oppression Pulse small and irregular Ninth day a triangular area of dulness was found, to the right one finger's breadth beyond the right sternal border and to the left two fingers' breadth beyond the nipple line Intercostal spaces to left bulged, and heart sounds could not be heard The superficial veins in the upper half of the thorax were widely dilated Diagnosis (Prof Fruhwald) Exudative pericarditis Patient became rapidly worse, and was pronounced moribund by a noted surgeon

*Operation* (March 10, 1903) —Prof v Eiselsberg Local anaesthesia Incision over sternal end of fifth rib Resection of fifth costal cartilage Test aspiration of the pericardium showed pus Cross incision of pericardium released about 1 litre of pus Rubber tube drainage (2 tubes) Strophanthus by mouth Three hours after operation pulse was easily felt, breathing full, color good, and mucosae red Streptococci found in pus Condition rapidly improved, but pulse was still irregular after 12 days and temperature ran between 37.8° and 39.5° Fistula remained open for 9 weeks, and while it was still open patient had scarlet fever No bad results

Nine years after, heart found in normal limits, tone full and pure Pulse regular Venectasia of right upper arm and shoulder For one year after operation the veins remained as thick as a finger

CASE III —IMERWOL (V) Boy ten years old Five years ago took cold and had pain in right side, but recovered perfectly Well since Twelve days ago he fell on a bench, and struck the left anterior part of his chest violently Two days later he appeared to have taken cold, and next day felt badly and went to bed with pain in the left side Fever

*Examination* —Fever, cough, dyspnoea Temperature 39°, pulse 130, regular

and full, respirations 36, rather diaphragmatic, and left side of thorax remaining immobile in respiration. Dulness on left from clavicle, embracing below the precordial area, and extending one finger's breadth beyond right sternal line. On the left the dulness continues to axillary line. Signs of fluid in left pleura. Broncho-pneumonia and congestion.

*Diagnosis*—Pleuropericarditis. Aspiration in seventh space, axillary line. No result. Condition gradually worse, with abdominal and precordial pain, loss of sleep from pain and cough. Streptococci in expectoration. Nine days after entrance into hospital an aspirator introduced into fifth left intercostal space in mammary line drew pus. Operation immediately, November 20, 1905. Incision 4 cm long in fifth intercostal space, commencing 1 cm from sternal margin (left), toward the left axillary line. Down to pericardium. Aspirated 250 grammes of pus. Incision and drainage (tube), introduced about 10 cm. Streptococci in pus. Cultures showed white colonies, Gram-positive. Rapid fall in temperature.

Patient had a stormy time with the broncho-pneumonia, but left the hospital with normal heart outlines and good action. No retraction of intercostal spaces.

CASE IV—IMERVOL (V). Boy, nine years old, entered hospital April 20, 1908. History negative until two years ago when he had "fever." Two weeks ago had chills and fever, pain in left side. Fever became high.

*Examination*—Patient looks sick. Dyspnoea. Temperature  $38.4^{\circ}$ , pulse 120, respirations 32, diaphragmatic. Precordial part of left thorax is distended. Complete dulness from left clavicle to base of thorax, and to the left to the axillary line. Precordial dulness goes to right border of sternum. Heart sounds regular, but feeble. Spleen enlarged. *Diagnosis* Exudative pericarditis and pleurisy.

May 5. Aspiration in axillary region, fifth interspace, gave pus from left pleura.

May 6. Aspiration in anterior axillary line, fifth interspace (left), 300 grammes seropurulent fluid. Aspiration of pericardium, fifth left interspace,  $3\frac{1}{2}$  cm from left sternal border gave pus. Improvement.

May 19. Pleurotomy in left fifth space, axillary line. 350 grammes of pus, drainage tube.

May 20. Discovered that the pericardium opens into the left pleura by an orifice. Heart sounds audible and apex beat visible. For the next four days this orifice increased in size. Case gradually improved and discharge lessened. Drains removed July 15, and gauze substituted. Wound cicatrized.

July 20. No retraction of intercostal spaces. Normal. Pus showed pneumococci.

CASE V—TALLQUIST. Housemaid, forty years old. Croupous pneumonia, empyema and purulent pericarditis.

March 23, 1911. Thoracotomy for empyema.

March 29. Pericardiotomy, Ollier's method. Fifth rib resected. Pericardium opened. 400-450 cc pus with fibrino-purulent exudate evacuated. Medium-sized drainage tube introduced and held by suture. After operation patient was in collapse, and cyanotic. Stimulated with camphor and caffeine. Temperature gradually declined from  $38.5^{\circ}$  to normal, and pulse from 120 to normal.

May 15. Patient's sputum showed no tubercular blood-cells. General condition good.

## SUPPURATIVE PERICARDITIS

CASE VI—*V* WISTINGHAUSEN (reported by *v* Dehn) Complication of pneumonia Dulness was demonstrable over cardiac and mediastinal areas An early radiograph showed the normally clear interspace between heart and hilus shadows was lacking The next picture after two weeks showed a more diffuse shadow Puncture over this dark area (area of greatest dulness) gave pus, which was removed by rib and cartilage resection Death occurred several days after operation, under symptoms of *Herzstamponade* Autopsy showed purulent mediastinitis and purulent pericarditis

CASE VII—*PIRADOIF* Armenian, twenty-six years old Came to hospital with incised wound over fifth and sixth ribs, parallel to sternum, 3 cm long, on the left side Was sutured by resident surgeon, and advised to stay, but refused Three days later he returned, with a temperature of  $40^{\circ}$  and shortness of breath, feeling of weight in precordium, pulse small and frequent The site of the wound suggested precardial trouble Examination showed heart fulness increased to the right, left and downward

*Exploratory Incision*—Superficial structures divided, exposing the fifth rib, which was found to be broken Fifth and sixth ribs resected, and pericardium exposed, showing a small wound Pericardium was opened Internal mammary artery ligated Blood-stained, foul-smelling fluid evacuated in large quantity Iodoform gauze drain Immediately after operation the respiration became better, and the pulse returned to normal frequency For several days he had an afternoon temperature, but on the fourth day it fell, and since has remained normal Now has no dyspnoea, his pulse is good, full and regular, and the heart outlines have returned to normal Wound healed

CASE VIII—*MINTZ* (W M) Male, twelve years old, developed pericarditis after a double pneumonia Was sick about two weeks His general condition was bad, vomiting Area of cardiac dulness extended two fingers' breadth beyond right border of sternum, and on the left to the midaxillary line

*Operation*—*Mintz* method, as outlined by him in 1903, and now used for the first time on the living patient Incision along the under border of the seventh costal cartilage A skin and cartilage flap is now made and opened from above downward, and access made to extraperitoneal space in which the pericardium can be opened without danger of wounding the pleura After opening the pericardium 100 cc of seropurulent fluid escaped, and a gauze drain was inserted Next day the normal area of cardiac dulness returned Patient's condition improved from then on, he had normal outlines at the end of 2 months, and no pain, but still had a small fistula Dismissed

CASE IX—*KILIANI* (discussion of Ellsworth Eliot's paper) Male, believed to be moribund Rheumatic arthritis and peri-endocarditis Leucocyte count 22,000 Immediate operation Under cocaine the fourth rib and cartilage were resected and the pericardium incised No pus found, due to the fact that it was pocketed back of the heart After some manipulation a few ounces of seropurulent fluid were evacuated and the man made a practically uneventful recovery Well seven years later

CASE X—*BLAKE, J A* (Discussion of Ellsworth Eliot's paper) On one occasion he opened the pericardium in axillary line, so much escaped that it covered the entire patient and table The case was interesting on account of the large amount of pus contained in the pericardial sac Great pain on introducing the drainage tube, and on one occasion irrigation caused collapse A few days



after operation there were signs of pus further back, and an incision there revealed an empyema. In this case the pericarditis was secondary to a double pneumonia, and probably to an empyema. The patient finally died.

CASE XI—WILLE (H) Boy, four years old. Admitted October 25, 1911. Discharged December 6, 1911. September, 1911, contracted tonsillitis, with high fever, pains in abdomen, and was confined to bed. No cough, but breathing was irregular. Transferred to hospital.

*Examination*—Lies on left side, with legs drawn up, groans continually. Appearance is pitiable. Temperature 40°, pulse 146, respirations 50, short and labored, labial herpes, nothing abnormal in heart, lungs or abdomen, urine normal.

October 5. Temperature had fallen to 37.6°–39.5°, respirations 54. Patient very pale and drowsy, lips dry. Left lower thorax showed a small swelling downward. Dulness on the left side from the second to the fourth ribs toward the axilla. Hyperresonance over right chest. Liver dulness began at fifth rib. Heart sounds weak, but clear and audible. In left axilla friction rubs could be heard, especially during expiration. Upper abdomen showed a swelling, but was tympanitic everywhere. Spleen and liver dulness normal.

October 6. X-ray showed a well-defined shadow, starting at the second rib and extending to diaphragm, occupying most of the thorax. No pulsation of the shadow. Aspiration in fifth intercostal space one finger's breadth to outer side of mammary line gave greyish, thick, fibrinous pus. Improvement.

October 17. Again aspirated, in same place, 100 grammes of pus drawn off. Culture showed streptococci.

October 25. Pericardiotomy. Incision with base along the left side, including fifth and sixth ribs, which were subperiosteally resected. Pleural reflexion showed about ½ cm from the margin of the sternum. It was pushed aside and pericardium punctured, and then incised. Two hundred grammes of non-odorous pus liberated. Heart worked fast. It was not situated against the anterior pericardium, but about 1 cm from it. Two medium thick drains were introduced back of heart. Dressing. Patient's pulse flew to 140, cyanosis, pulse hardly perceptible at wrist. Stimulation.

November 11. Temperature falling rapidly. Pulse 96–100. General condition steadily improving. Drainage now almost ceased (sixteenth day).

December 6. Wound healed. Heart sounds clear, pulse regular and normal. X-ray shows nothing abnormal. Discharged.

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# THE ABDOMINAL SKIN-FLAP IN RADICAL AMPUTATION OF THE BREAST

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VARIOUS plastic operations have been recommended for covering in the defect remaining after a radical amputation of breast with extensive skin removal. In a number of patients skin grafting is necessary.

The surgeon should never be influenced in the amount of skin he will sacrifice by considerations relating to the later closure of the wound. By extensive undermining of the skin it is often possible to close a wound whose edges it had seemed impossible to approximate. The same can be accomplished by plastic operations using flaps of neighboring skin.

During the past two years I have operated upon several patients with malignant disease of the breast, who had metastases in the skin of the chest wall below the breast, so that the radical removal of the disease required a widespread excision of skin and subcutaneous tissue. The large defect that remained could not have been closed by any of the plastic methods ordinarily used and skin grafting would have been necessary. By means of a large flap of skin from the abdominal wall the raw surface was easily covered over. The steps of the procedure are shown in Figs. 1-4 and can be understood without further explanation.

The skin of the abdominal wall is generally very lax and receives abundant blood supply from branches of the arteries which run through the wall of the abdomen from behind forward. If the base of the skin flap is not too small the tissues will be well nourished with blood, and there is no danger of sloughing or of marginal skin necrosis. After flap has been raised from fascia and slid upward into new position, there is no difficulty in closing the defect in the abdominal wall with interrupted sutures. It is surprising how much skin can be used for the flap and sufficient remain to close up the defect in the abdominal parietes without much tension. Size and shape of the abdominal skin flap will depend upon size and form of the raw surface on the chest wall.

The abdominal skin flap is necessary only in those cases in which the defect left after radical amputation of the breast cannot be closed by any of the methods ordinarily in vogue, it is useful after extensive removal of skin and makes skin grafting unnecessary. Nothing especially original is claimed for this plastic operation, but I believe that it should be considered the typical procedure in many cases.



FIG 1 —The skin incision for the removal of the breast and the diseased skin



FIG 2 —Part of the wound has been sutured. The abdominal flap is shown in outline



FIG 3 —The abdominal flap of skin and fat has been raised



FIG 4 —The abdominal flap in its new position and the entire wound closed by suture

# SPLENECTOMY FOR SPLENIC ANÆMIA IN CHILDHOOD AND FOR THE SPLENIC ANÆMIA OF INFANCY\*

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It is my purpose to lead, not to confusion, but rather to a distinction and a comparison by discussing in the same paper the adult form of splenic anæmia as it occurs in childhood and the splenic anæmia of infancy (anæmia pseudoleukæmica infantum) Anæmia pseudoleukæmica infantum, or von Jaksch's disease, seems to have no relationship clinically or pathologically to leukæmia, and it is agreed by such authorities as Wentworth,<sup>1</sup> Hutchison<sup>2</sup> and Ostrowsky<sup>3</sup> that this terminology should be discarded and the disease referred to as infantile splenic anæmia or the splenic anæmia of infancy The adult form of splenic anæmia as it occurs in children and the splenic anæmia of infancy have many characteristics in common as well as certain distinctive differences

The blood of children and particularly the blood of infants under two years of age differs normally from the blood of adults (Shaw<sup>4</sup>) A moderate leukocytosis which is essentially a lymphocytosis is quite constant and marrow-cells are occasionally observed A lymphocyte percentage of 40 and 50 in infants under two years of age is observed normally and this normal lymphocytosis is always to be taken into account in the consideration of any case of infantile anæmia It is also generally recognized that the blood of infants reacts differently than the blood of adults to various toxic agents A lower red cell count with a consequent higher color index, the occurrence of degenerated red cells, the presence of normoblasts and occasional megaloblasts, and a leucocytosis of 10,000, 15,000 or 20,000 with the occurrence of eosinophiles and myelocytes, are frequently present in the anæmias of infancy

The splenic anæmias of childhood and infancy have been divided by Hunter,<sup>5</sup> chiefly according to the blood picture, into three types *Type one* corresponds to the clinical picture of the splenic anæmia of adults There is a large spleen, a gradually developing or recurring anæmia, and the blood presents the picture of a secondary type of anæmia with a relatively low color index and an absence of leucocytosis Lymphocytes are present in a normal percentage, 40 or 50 per cent, and there is only an occasional normoblast to be found Hunter's *type two* includes cases in which the leucocyte count is between 10,000 and 20,000 and in which a variable number of normoblasts and megaloblasts are

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present in the smears The color index is relatively higher *Type three* embraces those cases in which the leucocyte count is above 20,000 and great numbers of normoblasts, together with occasional megaloblasts, eosinophiles and myelocytes occur Authorities seem to agree that there is no essential distinction between types two and three, and it would apparently be best to classify the cases into two groups First, those conforming to the syndrome of the splenic anæmia of adults with absence of leucocytosis, and second, those conforming to that of the splenic anæmia of infancy and showing a leucocytosis, the presence of a variable number of marrow-cells, and a relatively high color index

1 *Splenectomy for the Adult Form of Splenic Anæmia in Childhood*—Reports of cases conforming from a clinical stand-point to the adult form of splenic anæmia and Banti's disease in childhood are not uncommon in literature Reports of cases of this type in which splenectomy has been done are, however, much less numerous This discussion will be confined to patients of the first decade

Gaucher's disease, lymphosarcoma, septic splenomegaly, particularly as associated with endocarditis, and the splenomegalies of syphilis, rickets and hæmolytic jaundice are to be especially excluded in the differential diagnosis of splenic anæmia in childhood I have been able to collect from the literature five cases in which splenectomy has been done for conditions which conform, some of them imperfectly, to the adult type of splenic anæmia occurring in children under 10 years of age It is to be regretted that complete pathological descriptions of the spleen cannot be obtained in all of these cases, as the diagnosis is undoubtedly questionable in some of them Brief descriptions of the collected cases are reviewed and one case of our own is discussed in detail

Bland Sutton\* in 1895 performed a splenectomy on a girl aged five years, with an enlarged spleen and anæmia There was a negative family history and "leukæmia, syphilis, rickets and lardaceous disease were excluded" The spleen weighed 10 ounces Blood count and pathological description were not given Eighteen years later this patient seemed to be a perfectly healthy woman

Luce<sup>10</sup> reported a splenectomy (November 16, 1908) upon a girl aged six years The case was very carefully studied and conformed quite closely to the syndrome of splenic anæmia There was no history of syphilis and no familial tendency The spleen extended 5 cm below the costal margin and a blood count showed Hæmoglobin 30 per cent, red-cell count 2,100,000 and leucocyte count 6700 There was considerable evidence of blood destruction with an occasional normoblast in the smears The spleen weighed 240 grammes, there was a hypertrophy of the follicles, a relative atrophy of the lymphatic elements and marked engorgement of the sinuses Nine months after operation the patient was in excellent condition

Sutherland and Burghard<sup>11</sup> reported splenectomy (1910) in a girl aged six

## SPLENECTOMY FOR SPLENIC ANÆMIA

years, in whom the hæmoglobin was 30 per cent, the red-cell count 1,870,000, and the white count 2,400. A very faint jaundice was present. Two months after operation the hæmoglobin was 65 per cent. The spleen showed a generalized hyperplasia and weighed one pound. This case was reported as a splenic anæmia but is referred<sup>8</sup> to as a doubtful case of hæmolytic jaundice.

D'Espine<sup>9</sup> in 1913 reported a splenectomy in a case which he classified as Banti's disease in a sixteen-months-old girl baby. The spleen weighed 201 gms and showed a diffuse fibrosis. The anæmia was of the secondary type with a leucocytosis of 16,120 and the presence of an occasional normoblast. The child died six weeks later and at autopsy a glandular tuberculosis was found, but animal inoculation with splenic tissue gave negative results. D'Espine states that Banti's disease of adults probably dates from early childhood in many cases.

Barling<sup>11</sup> reported a splenectomy (February 25, 1914) in a girl aged six years, who had vomited blood 10 weeks previous. The spleen extended 3 inches below the costal margin. The hæmoglobin was 60 per cent, red-cell count 3,600,000 and the white varied from 7,000 to 26,000. This case cannot be accurately classified because of the fact that the differential count and pathological description of the spleen were not given. Death occurred on the fourth day after operation and at autopsy an acute hepatitis was found. Barling also mentions a splenectomy in a boy aged six, by French and Turner,<sup>12</sup> but this case would better be grouped with the splenomegalies associated with syphilis.

In our series of 68 splenectomies for various conditions (September 1, 1915) there has been only one in a patient of the first decade, and this one but a recent case. It will be seen that this case, of which a description follows, corresponding quite accurately from a clinical standpoint to the splenic anæmia of adults.

CASE A137566—F M D. A girl two and one-half years of age was first examined August 3, 1915. The family history was entirely negative and anæmia, hæmophilia and splenomegaly were inquired about particularly. There were four other children in the immediate family, all healthy, and the mother had had no miscarriages. The patient had evidently been entirely well until about one month before examination, when suddenly she vomited a large quantity of blood, estimated by the parents at one quart, and the stools became black for two or three days. Strength and color were promptly regained and the patient was soon quite well again. Two weeks before examination a second hemorrhage occurred, less severe than the first. After this second hemorrhage, however, the patient seemed to get progressively paler and weaker. An abdominal mass was found two weeks before examination. Ten days before examination an eruption which seemed to be urticarial in character appeared and disappeared again in 24 hours. There was slight fever at this time but a history of fever at any other time could not be elicited. The



appetite was poor, the bowels were regular and micturition was normal

On examination the child was found to be thin and very pale. The abdominal mass could be easily identified by its contour and notch, as spleen. It extended to a point below the level of the navel. The liver dulness did not seem to be abnormal. The superficial glands were very slightly enlarged. There was no fever. Wassermann test and Widal reaction were negative. The blood count showed a secondary type of anæmia with a color index of 4 and an absence of leucocytosis. The hæmoglobin was 20 per cent, a red-cell count was 2,010,000. The red cells showed marked anisocytosis and moderate polychromatophilia, and only one normoblast was seen while counting 300 white cells. There was no increase in the fragility of the red cells. The leucocyte count was 4000. A differential count of 300 cells showed polynuclear neutrophils 22·7 per cent, small lymphocytes 50 per cent, large lymphocytes 12·32 per cent, eosinophiles 12·3 per cent, basophiles 2·3 per cent, neutrophilic myelocytes 3 per cent.

*Operation* (D. C. Balfour, August 15, 1915) — Splenectomy in this case did not offer any marked technical difficulties, although the risk was apparently considerable on account of the patient's age and the severe degree of anæmia. A left rectus incision was made. The diaphragmatic adhesions rendered dislocation of the spleen somewhat hazardous. A long pack was interposed between the spleen and the oozing diaphragmatic surface to control the bleeding if possible without the necessity for suturing later. The œdematous condition of the tissues made them very friable and the pedicle had to be ligated with especial care. It was thought advisable to leave the hæmostatic pack in place until the incision had almost closed, and this proved efficacious. The patient's recovery from the operation was surprisingly good, there were no complications and she left the hospital on the ninth day.

*Pathological Report* (L. B. Wilson) — Case A137566, F. M. D. Weight of spleen 110 grammes, slight notch, moderate perisplenitis over convex surface, capsule not thickened, on section, gland somewhat tough showing considerable fibrosis, lymphoid areas well defined and increased in size. Microscopic examination shows moderate diffuse fibrosis (chronic splenitis), pulp 2, lymphoid tissue 3, reticulum 2, endothelium of sinuses 2, pigment 0, amyloid degeneration 0, arteriosclerosis 1+. It will thus be seen that the most marked changes were the increase in lymphoid tissues (non-diffuse) and stroma and the hypertrophy of the reticulo-endothelium of the sinuses. The arteriosclerosis, though small in amount, is of course unusual when the age of the patient is considered.

*Subsequent Condition* — Three days following operation the hæmoglobin was 27 per cent, the leucocytes had increased to 14,600, of which

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71·3 per cent were polynuclear neutrophils, and 76 normoblasts were seen while counting 300 white cells. Future reports will contain the ultimate result in this case.

2 *Splenectomy for the Splenic Anæmia of Infancy*—The splenic anæmia of infancy as a clinical entity was described by Gretscl<sup>13</sup> in 1866. To this syndrome he gave the name of "splenic anæmia of infants." Somma<sup>14</sup> in 1884 described the same condition under the title of "anæmia splenica infantile." Von Jaksch<sup>15</sup> in 1888 and 1890 brought the disease more clearly to the notice of the medical profession under the name of "anæmia pseudoleukæmica infantum." Many cases of the splenic anæmia of infancy have been reported in the literature, and much discussion has resulted, particularly concerning its relationship to rickets, syphilis and the gastro-intestinal disturbances. It seems to have been clearly shown that for the present, at least, it is useful to regard certain cases of severe secondary anæmia in infancy with marked splenomegaly and a more or less characteristic blood picture as a separate disease entity, in spite of the frequent association of rickets.

Splenectomy for the splenic anæmia of infancy has been performed, as far as I have been able to find, in but 4 unquestioned cases.

Wolff<sup>16</sup> in 1906 operated on a boy baby aged eighteen months, of whom there was a six months' history of illness. The spleen was very large, the blood showed a hæmoglobin of 40 per cent, a red-cell count of 467,000 and a white-cell count of 37,800. The differential count showed a lymphocytosis and the presence of mast cells and eosinophiles. There was a considerable poëcilocytosis and anisocytosis, and many normoblasts and megaloblasts were present. The child was in very poor condition. Ascites was present, the liver was enlarged and an operation was advised as a last resort. Splenectomy was performed July 29, 1905. The spleen weighed 500 grammes and showed an induration of the connective tissue framework, but no enlargement of the Malpighian bodies. There was no increase of lymphocytes in the spleen pulp. By the tenth day after operation the hæmoglobin had risen from 40 to 51 per cent and the red-cell count from 467,000 to 2,500,000, while the leucocytes were 36,000. Three years after operation this patient was presented before the Deutsche Gesellschaft für Chirurgie in excellent general condition. The blood picture was normal save that the leucocytes had remained increased.

Graff<sup>17</sup> in 1908 reported the case of a fifteen-months-old baby on whom splenectomy had been done in the summer of 1907. The family history was negative, the child had apparently been normal to the tenth month. After this time the appetite failed and the child lost weight, while there was a gradual increase in the size of the abdomen. At the time of the examination the patient was emaciated, scrawny, yellowish-white in color and weighed only 11 pounds. There was evidence of mild rickets. The spleen extended beyond the midline.

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† The numbers, 0, 1, 2, 3, 4, indicate the relative amounts of the several tissue elements.

and downward almost to the symphysis. The liver did not seem to be enlarged. The blood count showed a hæmoglobin of 45 per cent, a red-cell count of 1,800,000, with many normoblasts and a few megaloblasts. The white-cell count was 37,000 and an examination of the smears showed a lymphocytosis. The spleen measured 16 x 10 x 8 cm, and weighed one pound or nearly one-tenth of the body weight. It was very firm and hard. On examination it showed an increase of connective tissue, occasional hemorrhages and small collections of lymphocytes, and giant-cell-like structures similar to bone-marrow giant cells. There was no evidence of tuberculosis or tumor. After splenectomy the patient began immediately to improve. In 5 weeks the hæmoglobin was 50 per cent and the red-cell count had risen from 1,800,000 to 5,000,000. In 9 months the patient was quite well, weighed 21 pounds, and the blood was almost normal.

Fowler<sup>18</sup> performed a splenectomy in April, 1914, on a fourteen-months-old girl baby, in whom the spleen was much enlarged, the liver was apparently normal and the blood count showed a hæmoglobin of 50 per cent, a red-cell count of 3,316,000, giving a color index of 9 per cent, with many normoblasts and occasional megaloblasts in the blood smears together with a considerable variation in the size and the staining qualities of the red cells. The leucocyte count was 30,000 with polynuclears of 40 per cent, large mononuclears 12 per cent and small mononuclears 38 per cent. One month after operation the hæmoglobin was 65 per cent and the red-cell count 3,430,000, with occasional normoblasts and megaloblasts, the leucocyte count 15,000, of which the small mononuclears was 78 per cent.

Pool<sup>19</sup> performed a splenectomy on a boy baby of nine months on August 17, 1914, after a preliminary blood transfusion of 150 cc. The infant had been born at 7 months and nutritional disturbances had been troublesome. The child was very poorly developed, anæmic, and showed evidence of rickets. The liver extended 2 cm below the edge of the ribs and the spleen 5 cm below the left costal margin. A Wassermann test was negative. The patient had been on preliminary medical treatment for 6 weeks without improvement. The hæmoglobin before operation varied from 30 to 45 per cent, the red count from 1,400,000 to 2,400,000 and the leucocytes from 17,000 to 54,000. A differential count showed polynuclears of 35 per cent, eosinophiles 2 per cent, lymphocytes 49 per cent, transitionals 3 per cent, large mononuclears 6 per cent and myelocytes 5 per cent. Normoblasts had varied from 6 to 66 per 100 white cells and of these 2 or 3 were megaloblasts. Two months after operation the hæmoglobin had risen to 85 per cent, the red-cell count to 4,200,000 and the white-cell count had decreased to 13,300. The high lymphocyte percentage persisted but the normoblasts were decreased in number. Three months after operation the patient was reported to be not as well as he had been at 2 months.

None of our cases of the splenic anæmia of infancy has so far been operated on and my purpose in collecting these 4 instances of splenectomy for the splenic anæmia of infancy is to call attention to the fact that excellent results have been obtained in very severe types of the disease. Wolff's patient was in excellent condition 3 years after operation, Graff's patient had improved markedly 9 months after operation and Fowler's patient was in satisfactory condition one month after

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operation Pool's patient showed remarkable improvement for 2 months and at 3 months was reported as in a less satisfactory condition, but it must not be lost sight of that his patient was a premature child and had developed very poorly. It is emphasized by Wolff that splenectomy should for the present be reserved for severe cases of the disease. The milder types improve upon medical treatment, but the severer types die, usually of some intercurrent affection.

*Discussion*—An excellent conception of the varied types of disease in which anæmia is associated with chronic enlargement of the spleen in children and infants can be obtained from the several papers by Wentworth,<sup>1</sup> in which are given excellent reviews of reported cases. Wentworth concludes that the splenic anæmia of infancy is a secondary anæmia and in no way related to leukæmia. He also infers that the adult form of splenic anæmia may be a prototype of the splenic anæmia of infants. Hutchison<sup>2</sup> collected 22 cases of the splenic anæmia of infancy in patients from 9 months to two and one-half years of age. Ostrowsky<sup>3</sup> reports 10 cases of his own, varying in age from 7 months to 2 years with leucocyte counts of from 8000 to 25,000. Carpenter<sup>20</sup> in a review of 348 patients with splenomegaly, under 12 years of age, places rickets first and syphilis second in the etiological rôle. Ashby<sup>21</sup> concludes that the toxin causing rickets may also cause the splenic anæmia of infancy and that the reported cases vary from those with marked bone changes and small spleen to those with slight bone changes and a very large spleen. Carr<sup>22</sup> draws attention, however, to the following facts. First, that in a majority of rickety children there is no splenic enlargement, second, that there is no connection between the severity of the rickets and the size of the spleen or the degree of the anæmia, third, that in certain cases of the splenic anæmia of infancy there is no evidence, whatever, of rickets. The general experience seems to indicate that, granted the frequent association of rickets, there are yet certain cases which, on account of their marked splenomegaly and their severe anæmia, their evidences of extensive blood destruction, and a reversion to the fetal type of hæmopoiesis should, for the present at least, be grouped together as a separate disease entity.

Reports of cases of the adult form of splenic anæmia occurring in children under 2 years of age are very difficult to find, while the splenic anæmia of infancy seems practically never to be present in patients over the age of two and one-half years. This observation is in itself suggestive of the possibility that some relationship may exist between the two diseases. The chief clinical distinctions between the adult form of splenic anæmia and the splenic anæmia of infancy are in the blood

picture, and chiefly the characteristics of the leucocyte count. In the splenic anæmia of infancy there is more evidence of blood destruction than in the splenic anæmia of adults, the red-cell count is likely to be lower and the color index consequently higher, and normoblasts and megaloblasts are present in the blood smears. In the adult form of splenic anæmia there is an absence of leucocytosis while in the splenic anæmia of infancy there is a notable leucocytosis, which is, however, in reality a lymphocytosis. Our knowledge concerning the normal blood of infants and the reaction of the infant's blood to various toxic agents would lead us to regard these differences as less surprising. And especially does the biological fact that infancy is a transition period, in which there may be reversions to the fetal type of hæmopoiesis, have a bearing upon the variations in the infantile type of splenic anæmia. In addition to the above characteristics, we now have also the knowledge that splenectomy has been followed by excellent results in both conditions. These facts would suggest the possibility that the splenic anæmia of infancy may be a similar condition to the splenic anæmia of adults and that the differences may be largely due to the peculiar reaction of the infants' hæmopoietic system to the etiologic factor in the disease. For the present, and until our knowledge is much fuller, a sharp distinction should be drawn between the two conditions.

**SUMMARY** —1 The normal lymphocytosis of the infants' blood and its decided reaction to various toxic agents is always to be taken into account in the consideration of any case of infantile anæmia. Infancy is a transition period during which a reversion to the fetal type of hæmopoiesis is likely to occur.

2 The adult form of splenic anæmia as it occurs in children and the splenic anæmia of infancy have many characteristics in common, and also certain distinctive differences.

3 There is sufficient evidence to indicate a close relationship between the adult form of splenic anæmia as it occurs in childhood and the splenic anæmia of infancy. Until our knowledge is fuller, however, a sharp distinction should be drawn between the two diseases.

4 Splenectomy has been performed in only a few instances of the adult form of splenic anæmia occurring in the first decade of life. One case of this character is reported herewith. There is a doubt as to the exact diagnosis in some of the seven cases collected from the literature.

5 A review of the literature of the splenic anæmia of infancy (anæmia pseudoleukæmica of von Jaksch) shows that splenectomy has been performed in 4 instances of severe types of the disease, with marked immediate improvement.

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# PRIMARY SARCOMA OF THE GALL-BLADDER

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A REVIEW of the literature leads to the conclusion that primary sarcoma of the gall-bladder is an exceedingly rare disease. According to Iwasaki,<sup>1</sup> who recently reported a case and at the same time presented a synopsis of the earlier publications on the subject, there are only eight well-authenticated cases which have been described up to the time his paper was written. It is possible, however, that primary sarcoma of the gall-bladder is of more frequent occurrence. In some of its details the tumor may bear a close resemblance to primary carcinoma of the gall-bladder, and, therefore, among the large number of inoperable tumors of the gall-bladder found on exploring the abdomen, it is not unlikely that the two types of tumor have at times been confused.

The following case of sarcoma of the gall-bladder occurred in a woman thirty-eight years old who entered the St. Louis Mullanphy Hospital, May 14, 1915, on account of severe pains in the upper part of the abdomen and back. An abstract of the history follows. She was a housewife, married, German. Her father and mother were dead, the cause unknown. There was no history of cancer or tuberculosis. The patient was always well until three years ago when her present sickness commenced. The illness began with pain in the right upper quadrant of the abdomen and back. Attacks of pain continued at intervals up to time of entrance into the hospital, having increased in severity and frequency during the last six months. The pains required morphine for relief. At no time was the patient distinctly jaundiced, although she believed that on several occasions her skin was slightly yellow. She had experienced occasional nausea, and once in a while had vomited a bitter-tasting fluid. She lost about twenty pounds in weight during the last six months.

The patient was poorly nourished. Sensorium was clear. The skin was moist and cool. The teeth were in bad condition. A few small glands were felt on right side of the neck. The chest was poorly developed, but the heart and lungs were normal. The liver seemed somewhat enlarged, with moderate tenderness over the region of the gall-bladder. No tumor was felt. The entire

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abdomen was held rigid. There was no fever and the pulse was normal. The urine was clear in color and had a specific gravity of 1030. The urine showed a slight trace of albumen, but bile was not present. The examination of the stools was negative. A gastric analysis was made thirty minutes after giving a glass of water and two slices of bread. One hundred and twenty cubic centimetres of gastric contents were returned. This showed a trace of free hydrochloric acid. The total acidity was twenty-nine. The blood examination was normal. A radiograph of the abdomen showed no abnormality.

*Operation* (May 21, 1915) —The incision was made in the median line. Upon opening the peritoneum the distended gall-bladder sprang into the wound. The gall-bladder appeared much enlarged and felt thickened, due to an infiltration of its wall with a tumor mass. Calculi were felt through the wall of the gall-bladder. The liver seemed somewhat enlarged, but otherwise looked healthy, except at the site of the gall-bladder where the tumor had slightly invaded its substance. A careful search of the entire abdominal cavity showed no tumor tissue other than that of the gall-bladder, justifying the assumption that the neoplasm was primary in this organ. A cholecystectomy was done and the part of the liver invaded with tumor tissue was removed with the gall-bladder. As there was some oozing of blood from the wound, a drain was introduced and the abdomen closed except where the drain protruded. For two days after operation the patient did well, but on the third day she suddenly commenced to fail and continued to do so until May 25, when she died. Consent for the autopsy was not obtained.

The gall-bladder with the tumor attached weighs 69.5 grammes and measures 11 cm. in length and 4 cm. in width. The fundus of the gall-bladder appears considerably œdematous, its outer surface is of yellowish-gray color.

Occupying the central part of the gall-bladder and extending in the direction of the cystic duct is a large irregular tumor measuring 8.5 x 4 x 3 cm. The mass is formed principally by two large knobs of unequal size, the larger is found in the region of the fundus, while the smaller is found near the beginning of the cystic duct. The knob-like masses are connected by a broad ridge of tumor tissue which lies in the substance of the gall-bladder. On opening the gall-bladder a small amount of yellowish bile is noted. In the fundus are twelve faceted gall-stones, measuring 1.5 cm. in the longest diameter.

The mucous membrane of the gall-bladder appears to be intact. The small irregular folds are somewhat thicker than normal, and at several points in the fundus minute polyp-like projections are formed. Where the tumor has its greatest diameter, the mucosa appears smoother than usual, as if stretched by the underlying mass. On section, the



tumor is found lying directly below the mucous membrane, replacing the normal structure of the wall (Fig 1) The tumor tissue is smooth, homogeneous, and of dull white color It feels firm but not hard In several circumscribed areas, deep in the substance of the mass, a softening has occurred Such areas are microscopically found to be regions of widespread necrosis Necrotic areas contrast sharply with other parts of the tumor as they appear as yellowish-white points in a white field The nodular mass near the cystic duct presents several wide areas of necrosis, the largest of these measures 2.5 cm in diameter A pink zone of hyperæmia surrounds the necrotic tissue No points of hemorrhage are noted

In the region where the tumor is massive and has replaced normal structures, the wall of the gall-bladder measures 3 cm in thickness In that part of the fundus where tumor tissue does not exist, the wall of the gall-bladder has a thickness of 4 mm

Histologically, the tumor is a sarcoma composed chiefly of round cells (Fig 2) These vary somewhat in size but measure, after fixation in 10 per cent formaldehyde, usually 10 microns in diameter The nucleus of the cell is round or slightly oval, rich in chromatin and contains frequently a nucleolus The nucleus has an average measurement of  $7 \times 7$  microns The cytoplasm of the cell is clear or slightly granular and usually abundant in amount Less frequently the cytoplasm is scanty and surrounds the nucleus as a narrow ring The nucleus of cells containing a small amount of cytoplasm is found to be small, measuring 5 microns, and is more deeply stained In several sections the tumor cells assume here and there a spindle shape Spindle-shaped cells are always few in number and found in small groups These cells measure 18 microns in length and 5 microns in width and contain a nucleus 13 microns long and 4 microns wide Multinucleated cells or giant-cells are not found The stroma of the tumor consists of a network of fine fibrile and delicate connective tissue supporting small capillaries Mitotic figures are present in considerable numbers, irregular forms of mitosis are extremely rare In the sections areas of necrosis seem to be more plentiful than the gross inspection of the tumor indicates Besides the places in the tumor as already mentioned, where widespread necrosis has occurred, numerous small fields of necrosis are found on microscopical examination

Save for the epithelium of the mucous membrane, the wall of the gall-bladder at the site of the tumor has been replaced in great part by tumor tissue In the midst of large masses of tumor cells, occasional strands of muscle tissue are found These are often necrotic and are the remains of the muscularis Small bundles of hyaline connective tissue are also found scattered throughout the sections

In one section deep in the substance of the tumor, small tubules lined with columnar epithelium are noted, which probably represent remnants of the epithelial crypts of Luschka

A well-defined chronic inflammation exists in all parts of the gall-bladder The inflammatory changes involve chiefly the mucous membrane whose folds are thickened and project in a polyp-like manner into the lumen of the gall-bladder The epithelium in places has formed numerous small superficial tubules which resemble glands in their structure Lymphoid



FIG 1 —Gall-bladder showing the sarcoma lying below the mucous membrane replacing the deeper structures of the wall of the gall-bladder

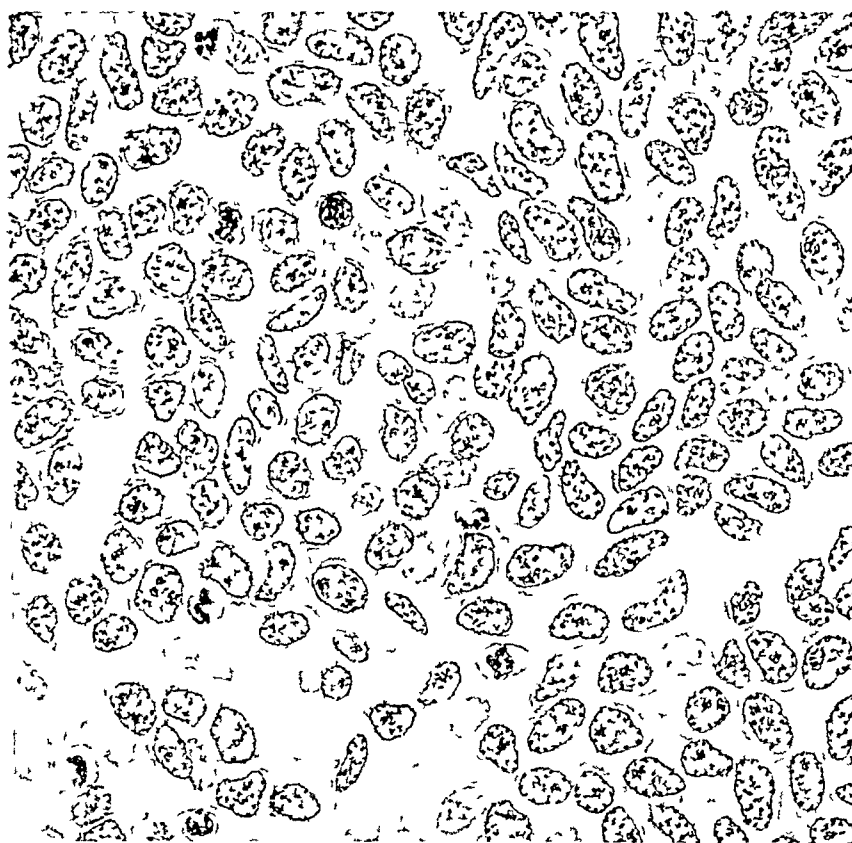


FIG 2 —Microscopic drawing of tumor ( $\times 300$ ) Round cells, at times slightly oval form the predominant cell of the tumor



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cells and plasma cells are present in large numbers infiltrating the inter-glandular tissue. In many places polynuclear leucocytes and large numbers of eosinophile cells are found.

The predominant cell of the sarcoma here described is a round cell, although occasionally spindle-shaped cells are found. The histological character of the tumor appears to differ in this respect from that of primary sarcoma of the gall-bladder in cases already reported which have often presented a more complex cellular structure. Thus, the case described recently by Iwasaki was polymorphous in character. The tumor, measuring 10 cm by 4.5 cm, was composed of long spindle cells, large round cells, small round cells and many giant cells. Two cases reported by Landsteiner<sup>2</sup> are described as myosarcoma. The predominant cells in both tumors were of the spindle type, yet numerous cells were found intermingled with spindle cells, which were regarded as smooth muscle. In one of the cases described by Landsteiner there existed in the gall-bladder, beside the sarcoma, an epithelioma which had arisen as a metaplasia of the mucous membrane and was invading the deeper structures of the wall.

Parlavacchio's case<sup>3</sup> was a spindle-cell sarcoma which presented many multinucleated cells as well. In places the tumor assumed the characters of mucinous tissue and was composed of star-shaped cells presenting fine anastomosing processes. The case of Hotes<sup>4</sup> was a spindle-cell sarcoma. Bayer<sup>5</sup> reported two cases. The first of these was a sarcoma composed chiefly of spindle cells, although in numerous areas round cells were found as well. The second case was a spindle-cell sarcoma with multinucleated giant cells. One of Landsteiner's cases contained in places hyaline connective tissue which had undergone calcification. In the second case reported by Bayer, islands of cartilage and bone were found.

The size of the tumor has varied considerably in the different cases of sarcoma of the gall-bladder which have been described. The tumor reported in this communication appears to be relatively small and measures only 8.5 cm in its greatest diameter. The sarcoma described by Landsteiner reached the diameters of  $19 \times 4 \times 8$  cm, filling the right side of the abdomen. The sarcoma of the gall-bladder, while still moderately small in size, is apparently confined to tissue below the mucous membrane, resembling in this regard the sarcoma of the stomach. In tumors of larger size, an invasion of the mucous membrane with tumor tissue occurs. In the case of very large sarcomas of the gall-bladder, the tissues of the gall-bladder itself can be identified

with difficulty as scattered remnants, or, indeed, may not be recognized at all. Large tumors are usually in the form of thick-walled cystic masses whose central cavities contain purulent fluid with necrotic tissue in which gall-stones may be found. There is a curious tendency in some of the tumors which have been described to grow in the direction of the cystic duct. The tumor under these circumstances projects as a conical mass into the lumen of the gall-bladder, the apex of the growth extending toward the cystic duct.

Invasion of the substance of the liver is common even in the case of small tumors. The involvement of the liver by an extension of the growth from the gall-bladder may become very great. Metastases into the liver at points distant from the gall-bladder have been described. In Landsteiner's case the metastatic masses were as large as 10 cm in diameter. Metastatic growths in other organs were also recorded. In the case of Hotes, the diaphragm was involved and the duodenum was imbedded in a mass of tumor tissue, while the mesenteric and pelvic lymph-glands, the appendix and the spleen showed nodules of tumor tissue. In Landsteiner's case, the neck of the gall-bladder was adherent to the duodenum, and two points of communication between gall-bladder and duodenum were noted. In several of the cases described there had been associated with the tumor of the gall-bladder a peritoneal exudate.

In all cases cited by Iwasaki, gall-stones were found except in one. As to whether stones precede or follow the development of the tumor, there is no certain way of determining. In the case here reported, the continuance of the symptoms of gall-stones for three years and a relatively small tumor which presented histologic evidence of rapid growth, makes it seem likely that the formation of stones and a chronic inflammation of the gall-bladder existed before the development of the tumor. At all events, it is probable that the development of the gall-stones preceded the period when the tumor assumed an active and invasive growth.

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## RESECTION OF THE CARDIA FOR CARCINOMA\*

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BEFORE starting my remarks on the resection of the cardia for carcinoma I almost feel like apologizing for writing this paper on the basis of two operations, the outcome in both of which was fatal. However, I am so absolutely convinced, not only of the technical possibility of the work in all its varieties, but also of the possibility of a more frequently successful issue than has hitherto been obtained, that I venture to submit my experience to you.

It is a well-known fact that the œsophagus has four places of stricture, physiologically

- 1 Near its very beginning, behind the cricoid cartilage at the neck
- 2 Behind the bifurcation of the trachea
- 3 At the hiatus œsophageus of the diaphragm
- 4 At the cardia

As in other portions of the gastro-intestinal tract, it is for the very places of physiological stricture that cancer seems to have a predilection. No doubt the manifold lesions, to which these spots are continuously subjected by the ever-recurring descent of the chewed food, favor its development in patients cancerously inclined.

To differentiate cancer of the œsophageal hiatus from that of the cardia may be correct from a pathologic point of view, clinically it is not so. v Hacker pointed this out years ago and proposed combining the two types under one heading.

Expressed in percentages and round figures the frequency of cancer of the œsophagus with reference to location is as follows: Neck, 10 per cent, bifurcation, 40 per cent, hiatus, 27.5 per cent, cardia, 22.1 per cent, or, the latter two combined and grouped under the common head of "cancer of the cardia," almost 50 per cent, one-half of the cases. If we add to these the malignant tumors that grow at the lesser curvature, near the cardia, and clearly belong to this group, at least from an operative point of view, it will become evident that cancer of the cardia is not a particularly rare disease. And cancer of the œsophagus takes the fifth place in the table of frequency of all carcinomas.

Within the last decade cancer of the cardia, with other malignant

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\* Read before the American Surgical Association, June 10, 1915

œsophageal strictures, has passed within the scope of operative surgery. Attempts at its resection have often been made. The first successful case dates back seven years.

A perusal of the literature shows that so far five cases have made an operative recovery. Every one of them was treated by a different plan of operation.

CASE I—Voelcker of Heidelberg, in 1908,<sup>1</sup> operated on a female, aged sixty-two years, entirely by way of the abdomen. With the help of an oblique incision from the ensiform process to the axillary line and division of the seventh cartilage near the sternum, free access was gained to the seat of the trouble. He was so fortunate as to find the cardia descended and the normal œsophagus running for 2 cm. within the abdomen, proximal to the malignant stricture. After having mobilized the œsophagus at the diaphragm he could pull the tumor down for another 4 cm. Thus it proved feasible to work within the abdomen throughout. He resected the tumor and united the divided ends of the œsophagus and the stomach by Billroth's method No. 1 (Fig. 1). Gastrostomy was added and the region of the operative field tamponed. There was some leakage at the anastomosis for four weeks, during which time the patient was nourished through the gastric fistula. Then union became perfect. The fistula closed at the end of the seventh week, when the patient left the hospital. A week thereafter she was able to swallow any kind of food and had greatly improved in general health.

Voelcker operated upon two other patients for the same trouble. Both died. In one the adherent spleen had to be excised, Murphy's button was used for the anastomosis, leakage on eighth day, death on twenty-fourth day after operation.

In the other case the cardiac tumor was pulled through an incision in the posterior wall of the stomach after gastrotomy, mucosa sutured from within, seromuscular from without, the tumor being gradually cut off. The various steps could be nicely and exactly carried out, death twenty-four hours later.

Autopsy showed chronic granular nephritis.

CASE II—The second successful case was reported by Kuemmel, of Hamburg, and operated in 1910.<sup>2</sup> He, too, worked entirely by way of the abdomen, under venous ether anæsthesia. After mobilization of the tumor within the diaphragm, he could pull the œsophagus down for a distance of 10 to 12 cm. (!). Direct union appeared possible. Murphy's button was introduced, but its halves could not be closed. There was too much tension. Button was removed. In this emergency the only way out of the dilemma was to tie a rubber tube into the œsophagus, letting the other end of the tube pass out of the abdominal wound. Part of the hole in the stomach was used for gastrostomy (Fig. 2, diagrammatic). Tamponade. Gradual contraction of the wound, bringing the two openings closer and closer, introduction of a rubber T-tube, with which patient was able to swallow (Fig. 2). The T-end was to be used in case any difficulty in direct swallowing should arise, it did not come into use. At the time of the report, ten weeks after the operation, a small fistula still had to close up, the patient had greatly improved.

<sup>1</sup> Verhandlungen der Deutschen Gesellschaft f. Chir., 1908, vol. 1, p. 126.

<sup>2</sup> Verhandlungen d. Deutschen Gesellschaft f. Chir., 1910, vol. 1, p. 96.

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In another case, done by Kuemmel a few years before, also with Murphy's button, leakage caused peritonitis and death

It seems to me that Voelcker's and Kuemmel's experience must be looked upon as rather exceptional. We certainly shall not be able, in the average case, to pull the œsophagus and cardia down into the abdomen for a sufficient distance to enable us to do the entire resection within the abdominal cavity, because the lower portion of the œsophagus will usually be found more or less involved in the disease<sup>3</sup>. The healthy portion of the œsophagus above the upper end of the tumor can then not be reached from below with sufficient ease to insure good surgery.

It is in these cases that abdominal and thoracic surgery join hands. Not infrequently one or both pleural cavities will have to be opened. We must therefore be prepared, and make the necessary arrangements to overcome the dangers of an acute pneumothorax. Any one of the three principal methods of avoiding it by means of differential pressure can be used, most conveniently intratracheal insufflation.

Referring to the experience of Voelcker and Kuemmel with the Murphy button in their attempt at immediate union between œsophagus and stomach, one can well understand how this otherwise useful button should fail in these cases for the reason that the œsophageal musculature has no serous cover. Tiegel's button satisfactorily answers the requirements, as it was designed for this particular class of cases. After approximation, the field of operation is invaginated into the stomach.

CASE III—Sauerbruch made use of this device in a case of circumscribed malignant infiltration of the cardia<sup>4</sup>. He worked through the thorax and, after excision of the tumor and suture of the stomach, could pull the latter up sufficiently into the chest, to accomplish a good anastomosis (Fig. 3). The patient recovered from the operation, but contracted a right-sided pneumonia on the fourteenth day, to which he succumbed. Autopsy showed a perfect operative result without infection of pleura or mediastinum.

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<sup>3</sup> Nunberg, of Navarro's Clinic at Genoa, recently published an article (*Beitr. f. klin. Chir.*, Bd. 95, Hft. 3, March, 1915) in which he points out the erroneous-ness of the belief held by some, that we can pull down the œsophagus for a distance into the abdomen in the presence of a tumor at its entrance into the stomach. He believes that without loosening the œsophageal adhesions farther up in the posterior mediastinum, downward traction will prove ineffectual, and that the upward displacement of the diaphragm at the foramen œsophagæum (with hand or retractor) alone is responsible for better access to the upper portion of the œsophagus. Personally, I believe that Nunberg's views are correct in part. Further clinical observations will throw more light on this interesting question.

<sup>4</sup> *Technik d. Thorax Chir.*, 1911, p. 87.



Sauerbruch was fortunate in having a case in which, after resection, he could transpose the stomach upward sufficiently into the thorax to enable him to do an immediate anastomosis without undue tension

These cases are the exception, however, not the rule. At the stage in which patients usually reach us at the present time they require wide removal, so that direct union is out of the question. Besides, during primary gastrostomy the pyloric portion of the stomach is fastened to the anterior abdominal wall, and renders illusory any attempt at pulling the cardiac portion up into the thorax for a safe anastomosis.

For these advanced cases a method has been worked out in the course of the last years, which promises to become standardized. This is a 2- or 3-stage operation which consists in

(a) Gastrostomy with careful palpation of the conditions at and around the cardia

(b) Excision of the tumor, at the same time construction of a new exit for the proximal (oral) stump of the œsophagus

In weak patients and cases with extensive involvement of the œsophagus, this second stage may have to be divided once more, so that the operation will become a 3-stage one.<sup>5</sup>

The lower end of the proximal stump may be led out laterally in the axillary line, while the upper portion remains *in situ* and undisturbed within the posterior mediastinum, or the entire proximal portion of the œsophagus is removed from its normal place in the posterior mediastinum and placed antethoracically under the skin of the left side of the chest—partial superior œsophagoplasty.

CASE IV—J. H. Zaaijer, first assistant to the Surgical Clinic at Leiden, Holland, reports a successful transpleural resection of the cardia, 1912, in which the lateral exit of the œsophagus was chosen.<sup>6</sup>

Male aged fifty-four years, 3-stage operation

First stage. Exploratory laparotomy to ascertain the operability of the carcinoma, establishment of a gastric fistula (Kader)

Second stage. Subperiosteal resection of long pieces of the sixth to twelfth ribs

Third stage. One month later, under positive differential pressure incision of peritoneal and left pleural cavities, resection of cardia, closure of stomach wound. Mobilization of proximal œsophageal portion, suturing its cut surface into parietal pleura and skin within an axillary line-incision. Fig. 4 represents condition of patient twenty-two days after operation. The rubber tube, connecting œsophageal with gastric fistula, enabled the man to take liquid and semisolid food by mouth.

<sup>5</sup> Cf. author, *Centralbl. f. Chir.*, 1914, Nos. 2 and 32.

<sup>6</sup> *Beitr. z. klin. Chir.*, vol. lxxxiii, 2.

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Zaaijer's excellent work and its successful outcome must command our admiration. But to provide a lateral exit of the oral œsophageal stump does not seem to be the most desirable procedure. The gastric fistula is usually established anteriorly through the left rectus muscle. In the Beck-Jianu method of gastrostomy, which includes partial inferior œsophagoplasty by making use of the major curvature of the stomach,<sup>7</sup> is the opening of the new tube that leads down into the stomach also placed anteriorly on the left side of the chest, at a level with the fourth to second rib cartilage or still higher. It therefore seems but rational to try to have the exit of the proximal œsophageal stump anteriorly in the parasternal, not laterally in the axillary line. Ach's and Torek's successful cases prove that this method, first proposed by v Miculicz and Kelling, in 1904, and so splendidly worked out experimentally by Ach, of Munich,<sup>8</sup> is a useful one and deserves our most earnest attention.

CASE V—Male, aged fifty-two years, operated upon by Ach on June 7, 1912, with resection of the cardia, a most important case, marking, I believe, a mile-stone in the evolution of œsophageal resection. Ach did the whole operation, including gastrostomy, in one sitting, in the stupendously short time of one hour and twenty-five minutes. Fig 5 illustrates the extent of the resected tumor. However, the principal addition Ach has made to œsophageal surgery for carcinoma is his method of extracting the tube from the posterior mediastinum, which greatly simplifies the transposition of the proximal stump, after resection of the stricture in any part of the œsophagus. Details of the procedure are given below.

Some authors consider the extraction of the œsophagus through a wound at the neck a dangerous procedure, because the nourishing arteries of the œsophagus, which are derived directly from the aorta, have to be torn and may give rise to secondary hemorrhage. This has been more recently emphasized by A Hirschman.<sup>9</sup> However, Ach's multiple animal experiments plus three operations on the human subject, in none of which secondary hemorrhage occurred, seem to refute the fear expressed, and furnish a strong argument in favor of this easy and simple extraction method.

Rehn, Jr, advises extractions of the inner layer of the œsophagus only, leaving the muscularis in place.<sup>10</sup> This may well be done in a healthy dog, but how it could prove practical in the case of a sick human

<sup>7</sup> See author, *ANNALS OF SURGERY*, September, 1913, *Jour Amer Med Assn*, January 10, 1914, *Surgery, Gynecology and Obstetrics*, February, 1915.

<sup>8</sup> *Beitr z Œsophagus Chirurgie*, Munchen, 1913.

<sup>9</sup> *Beitr f klin Chir*, March, 1915, vol xcv, 3, p 469.

<sup>10</sup> *Œsophagus Chirurgie*, Jena, 1914.

being with an œsophagus harboring a malignant tumor in all its layers is hard to see

Ach's first patient treated with extraction of the œsophagus made a splendid operative recovery, but, unfortunately, died in consequence of leakage of the gastric fistula on the seventeenth day after operation. Autopsy proved an ideal result of the cardiac resection and of the œsophageal transposition. Ach reports two additional operations of this type done on men fifty and fifty-four years old, in which the same plan was followed. Both patients died of pneumonia, one of additional mediastinitis on the fourth day after the operation. Both are of interest, inasmuch as the pyloric portion of the stomach, which, after resection and suture, had the shape of a longitudinal tube of 12 to 15 cm. in length and somewhat more than a thumb's size, was made use of for inferior œsophagoplasty according to the Beck-Jianu method. This brought the entrance into the stomach up to a line above the mammillæ and obviated the dangers of possible leakage of a typical gastric fistula, established at the same sitting.

Ach expects to be able to remove all œsophageal carcinomas situated below the aortic arch by way of the abdominal route, with extraction of the proximal stump according to his method. He is not in favor of the transpleural route which, of course, permits of exact surgical work under the guidance of the operator's eyes, but on the other hand involves protracted work within the pleural sac. Further practical experience in man will have to decide the advantages or disadvantages of the different advances. Most likely both procedures will have a lasting place in œsophageal surgery.

The details of Ach's method will be seen from the description of the two operations done by me, in which I tried to follow his steps as much as cases and conditions warranted.<sup>11</sup> The technical difficulty in both was that the operation had to be done in the presence of a gastric

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<sup>11</sup> In justice to Ach as well as for the sake of completeness I shall briefly outline the sequence of the various steps of the operation as done by him. No primary gastrotomy, single-step operation. Left oblique abdominal incision, thorough exploration of tumor and operating field, exposure of œsophagus at neck, tamponade of this wound. Isolation of tumor beneath diaphragm, preparation made for use of positive pressure (Brauer's apparatus). Both pleural cavities had to be opened, cutting of nervi vagi above tumor, application of clamp about three-quarters inch above same, perforation of œsophagus at upper edge of clamp with needle and long linen thread, ligation, second clamp to tumor, division of œsophagus between. Ligation of omentum minus, inclusive of left superior gastric artery, clamped cardia covered with gauze compress, extraction and transposition of proximal stump as described in this article, fixation of rubber tube in projecting portion in front of skin wound, closure of neck wound.

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fistula, the integrity of which had to be preserved at all hazards. None of the five surgeons, mentioned above, had to deal with this complicating feature.

The feasibility of such preservation of the gastric fistula, when operating on the cardia, I could prove years ago, in a boy, aged fourteen years, who had an absolutely impermeable cicatricial stricture of the œsophagus since his sixth year. Entrance into the stricture from above with the help of œsophagotomy had proved futile. I therefore tried the retrograde way with the help of the osteoplastic resection of the costal arch and gastrotomy, without, however, carrying my point. The bone flap was replaced and the patient made a good recovery with preservation of perfect function of the gastric fistula (Fig. 6)<sup>12</sup>

PERSONAL EXPERIENCE — CASE I — Man, aged fifty-four years, Post-graduate Hospital, service of Dr. L. Kast, who very courteously referred the patient to me for operation. Typical cardiac stenosis, the presence of which had been proven by all modern means. Wassermann negative, but patient had specific infection when young. Œsophagoscopy omitted, because bougie had caused marked subjective trouble and the stenosis demanded prompt relief. Gastrostomy (Witzel), December 15, 1914. Palpation done on this occasion revealed an irregular, nodular, circular tumor, the size of a lemon, below the diaphragm, and a number of infiltrated glands near either curvature, no secondary deposits elsewhere palpable, the mass was well movable, not adherent to diaphragm or spleen.

The tumor was undoubtedly operable. I am sure every surgeon would have found the strict indication for resection, had a tumor of the same size and character been found at the pylorus. So I decided to go ahead.

After forced feeding through gastric fistula with self-masticated food for a few weeks, January 19, 1915, radical operation. First assistant, Dr. M. Rehling, intratracheal insufflation (Dr.

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by layer sutures. Change of rubber gloves. Careful mopping of posterior mediastinum, suturing of the muscle bundles, which surround the hiatus œsophageus and of the covering diaphragmatic peritoneum. Ligation and division of omentum majus and the rest of omentum minus, distal to infiltrated lymphatic glands, transverse resection of stomach at a safe distance from the distal end of the tumor, closure of stump, layer suture of abdominal wound, fastening stomach at inner angle of latter where the rubber tube in a Witzel's gastrostomy is made to emerge, dressing of neck, thoracic and abdominal wounds.

<sup>12</sup> See Med. News, October 29, 1904, and Jour. Amer. Med. Assn., October 6, 1906, Osteoplastic Resection of the Costal Arch in Order to Reach the Vault of the Diaphragm.

C Eggers) Stomach lavage, rubber tube removed from gastric fistula and canal blocked with a tampon of iodoform gauze and covered with sterile strips of zinc adhesive plaster, which were thoroughly iodined. Pronounced lumbar lordosis on sand bag, second bag under left hip, producing a moderate right lateral posture. An operating table of the newest construction will greatly assist in producing the desired posture (Figs 7 and 8). If still no satisfactory access can be had, Kelling's posture might be tried<sup>13</sup> (Fig 9). Oblique skin incision, parallel to left border of ribs and then up into axillary line, carefully avoiding interference with gastric fistula (Fig 10). (The gastric tube was left in place in the illustration in order to emphasize the presence of the gastric fistula.) Division of muscles, blood-vessels ligated, opening of abdomen. As seen before, in an operation on the cadaver, access to the cardia was unsatisfactory without division of the left rectus muscle. This, however, was not feasible here on account of the necessity to preserve the gastric fistula. Therefore resection of twelfth and eleventh ribs, which makes tissues somewhat more movable. Tumor was of same size as five weeks previously.

Place for transverse division of stomach selected and major omentum ligated and divided toward cardia, including infiltrated glands and vasa brevia in front of spleen, the latter can be pushed off. The broad band which binds the tip of the left lobe of the liver close to the foramen œsophagæum of the diaphragm was then divided in order to be able to push the liver lobe more to the right. But little room was gained thereby. The stomach was now surrounded by the two forefingers, distal to the lower border of the tumor, and turned upward around its longitudinal axis for almost 180°, thus permitting ligation and division of omentum minus beyond its infiltrated glands, left superior gastric artery was caught in the last mass ligature (Fig 11). Technically, this work was not easy, it had to be carried out in a sort of funnel, because the costal arch did not sufficiently yield to the assistant's traction with a large blunt hook, and I had made up my mind to avoid osteoplastic resection of the arch. Followed gradual, blunt loosening of cardiac tumor, which was not difficult. Tumor infiltration ran up on the œsophagus for fully one and a half inch. On pulling the mass downward, the thoracic portion of the œsophagus descended only a trifle, surely not the way Voelcker and Kuemmell had seen it in their cases, although all adhesions around the cardia had been severed as much as possible. Firm adhesions around œsophagus in posterior mediastinum were palpated further up. Transverse double line of sutures of stomach

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<sup>13</sup> See Centralbl f Chir, 1901, No 42

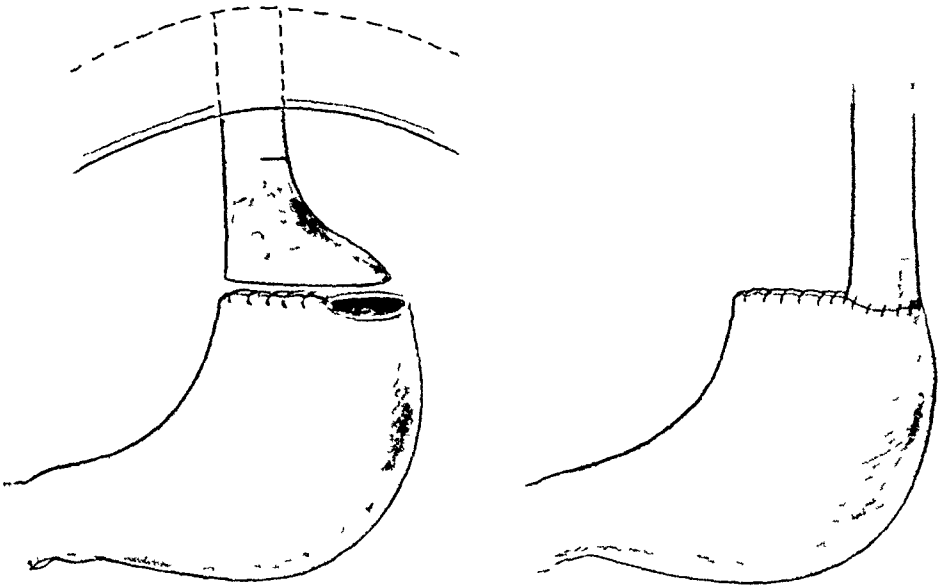


FIG. 1—First successful case of resection of the cardia for carcinoma (Voelcker Heidelberg 1908. Diagram drawn by writer). Removal of tumor entirely from below through the abdomen. Immediate end-to-end union by Billroth's method No. 1. Tamponade, temporary leakage, recovery.

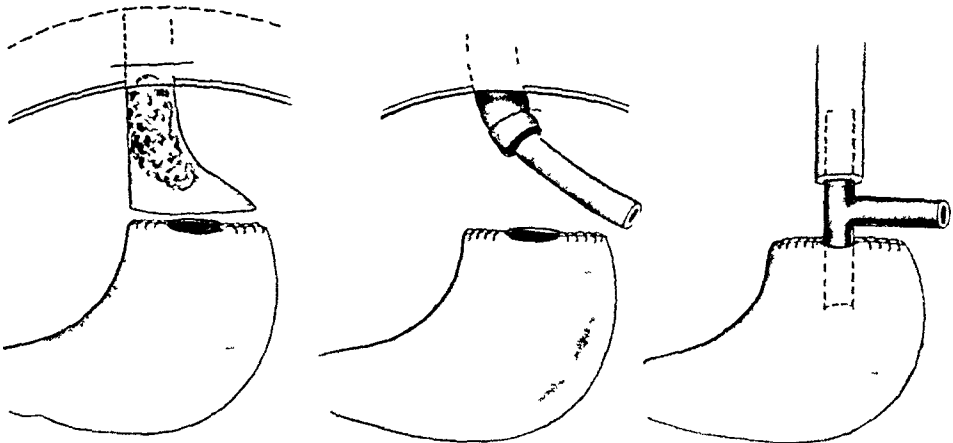


FIG. 2—Second successful case of resection of the cardia for carcinoma (Kummell Hamburg, 1910. Diagram drawn by writer). In this case, too, the operation could be done entirely within the abdomen, pleural sacs were not interfered with as cardia after being loosened could be pulled down for a distance of 10–12 cm. Immediate union impossible as distance between resected parts was too long, tube tied in oesophagus, gastrostomy, subdiaphragmatic tamponade, later T-tube, gradual closure.

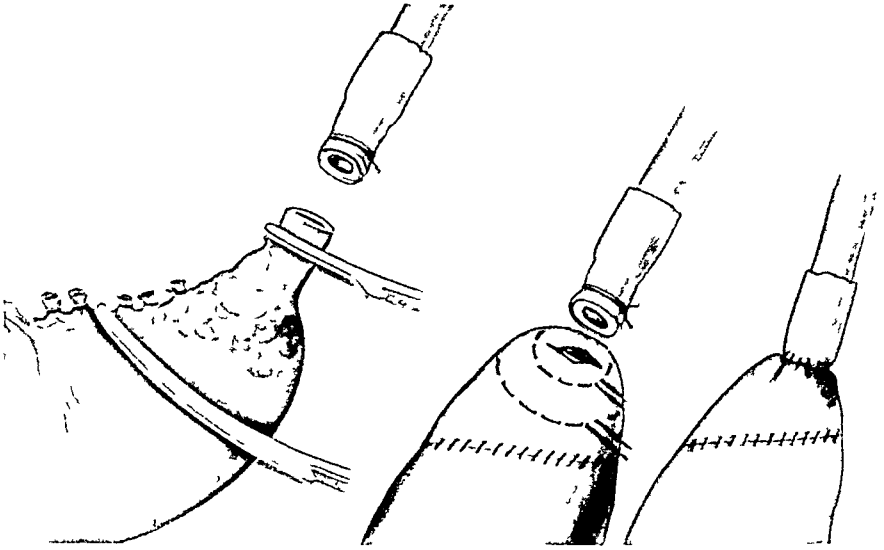


FIG 3—Third successful case of resection of the cardia for carcinoma operative recovery (Sauerbruch Zurich 1910) Transpleural operation under differential pressure growth loosened from above excision of tumor closure of stomach latter pulled up above diaphragm into thoracic cavity and anastomosis carried out with Tiegels button Operative recovery, pneumonia on fourteenth day, exitus (Illustration from Sauerbruch und Schumacher *Technik der Thoraxchirurgie* p 91)



FIG 4—Fourth successful case of resection of the cardia (Zaaijer Leiden 1912) After gastrotomy and resection of lower ribs in first and second stages combined thoracotomy and abdominal section, excision of tumor, proximal stump left *in situ* its lower end brought out in axillary line patient well able to swallow after introduction of rubber tube (Illustration from Zaaijer's article 1 c, rubber tube added to it by writer)

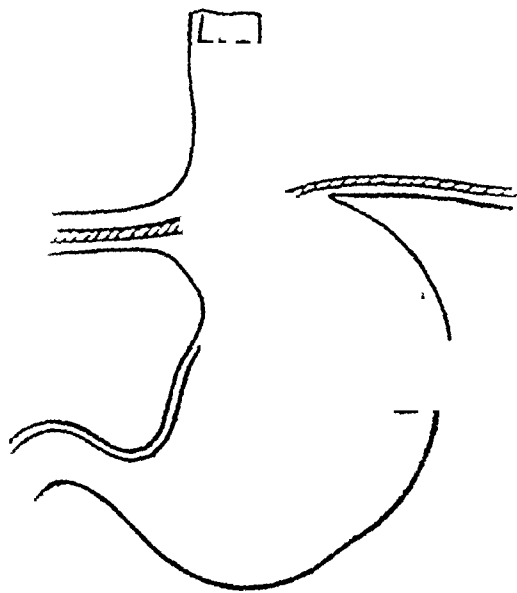


FIG. 5—Fifth case of resection of the cardia for carcinoma, operative recovery (Ach. Munich 1912). The thickened part in the diagram represents extent of tumor. Excision done from abdomen, extraction of proximal stump of divided oesophagus by special method, gastrotomy added. Eleven days later beginning insufficiency of gastric fistula to which patient succumbed on seventeenth day after operation. (Illustration from *Ach. Beitrage / Oesoph. Chirurg.* p. 72.)



FIG. 6—Gastrotomy with the help of an osteoplastic resection of the costal arch in the presence of a gastric fistula by means of a V shaped incision for impermeable cicatricial stricture of the oesophagus (author). Recovery from operation (see *Journal of American Medical Association* October 6 1906)

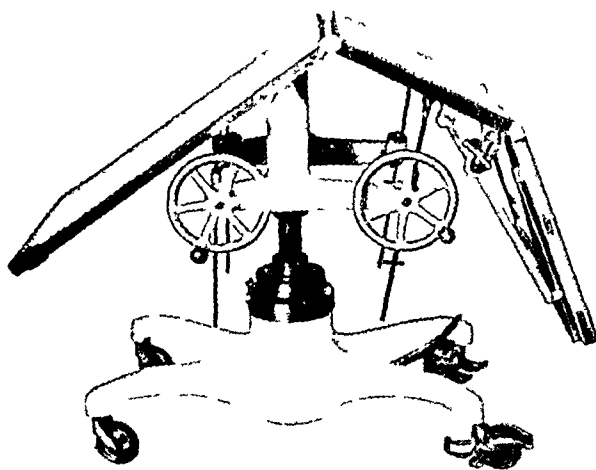


FIG. 7—Operating table of latest type permitting of pronounced lordosis





FIG 8 —The same patient in position for operation

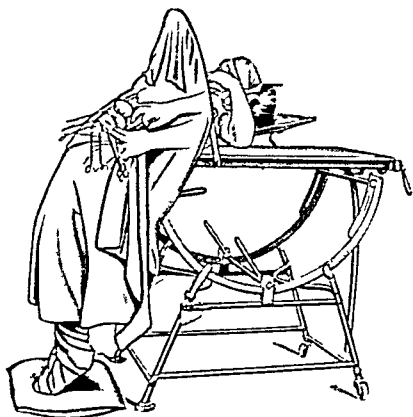


FIG 9 —Kelling's posture for infradiaphragmatic work with patient's feet hanging down perpendicularly the upper half of the body alone remaining on the operating table. This posture gives excellent access.

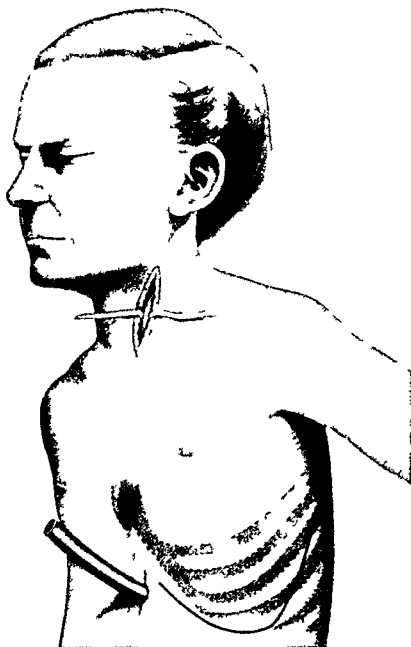


FIG 10 —Oblique abdominal incision in presence of gastric fistula. The artist has left the tube in place for demonstration. For the operation the tube had of course been removed and the fistula plugged with iodoform gauze and covered with sterilized adhesive plaster which in addition had been painted with tincture of iodine.

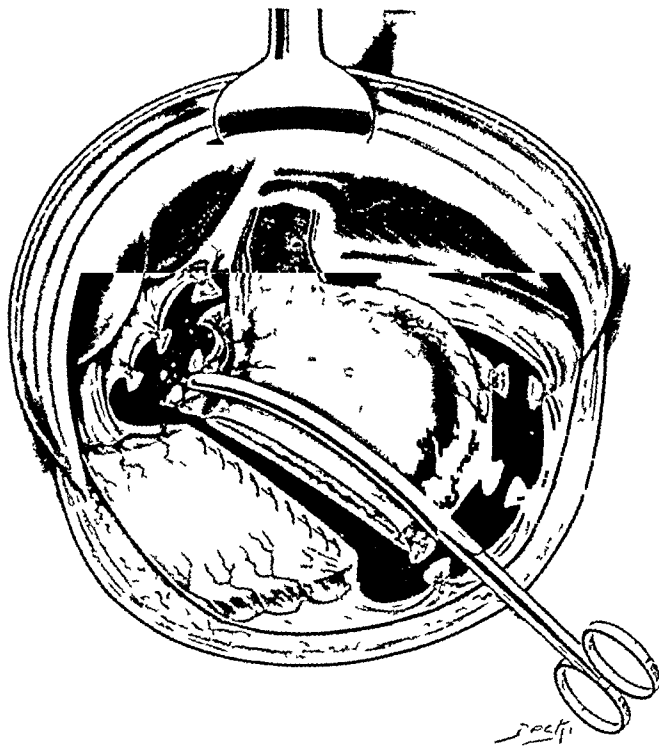


FIG. 11 —Omentum majus and minus doubly ligated and cut the last ligature of the latter includes left superior gastric artery stomach divided distal end sutured proximal clamped. In the case reported the transverse cut of the stomach was accomplished with Hueltl's wire stitching instrument the distal part of the stomach being at once inverted and secured by a running silk suture.

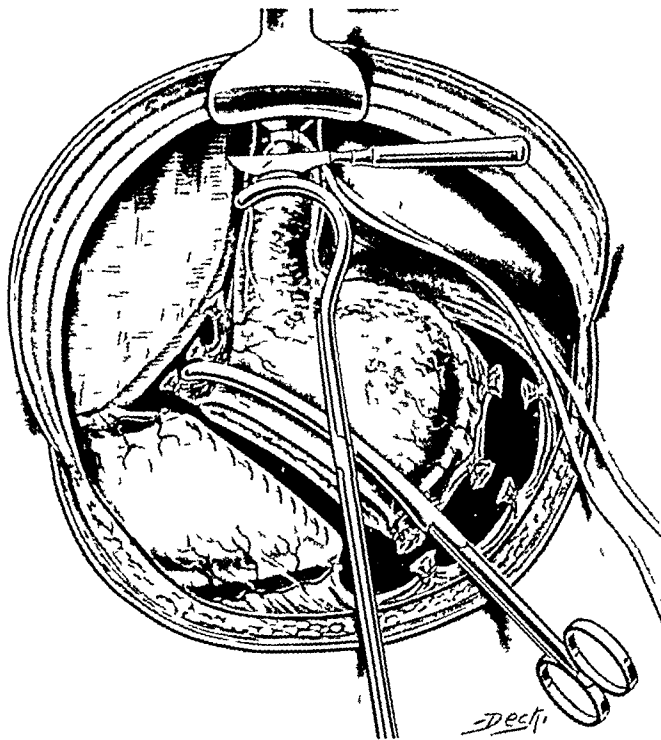


FIG. 12 —Liver covered with gauze sponge, tumor loosened in foramen œsophagœum its upper end clamped with curved forceps, the proximal portion of the œsophagus, about one inch above tied off with a piece of narrow tape the ends of which are left long. Nervi vagi divided knife ready to cut through the œsophagus. A blunt hook placed in the posterior mediastinum facilitates access.

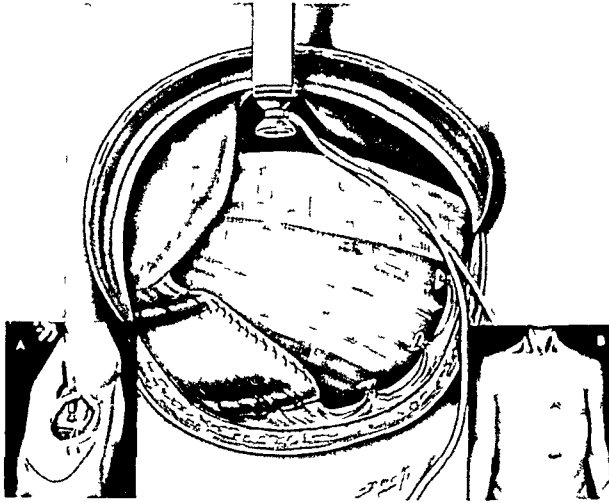


FIG 13 —Tumor removed operating field within abdomen covered with gauze the tape left long after ligation hangs out of the wound A Shows additional thoracotomy and the result of procedure which became necessary in order to place the proximal esophageal stump in front of the aortic arch before extraction from the neck could be done B Operation finished, esophagus transplanted subcutaneously under the left side of the chest

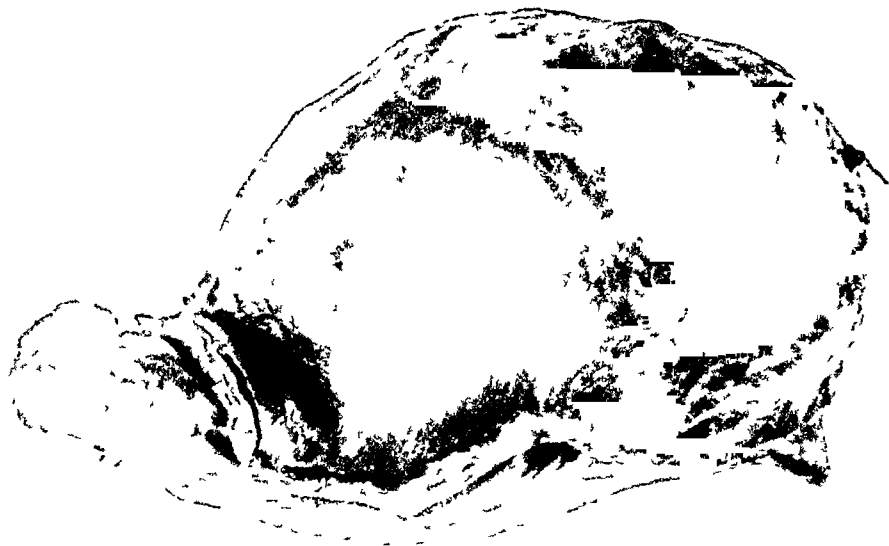


FIG 14 —Specimen removed from Case I Photograph taken six months after operation Specimen kept in formalin (natural size)





A



B

FIG 16.—Specimen (A) removed from second patient operated on B shows the cardiac pouch which had been cut off inadvertently (natural size)

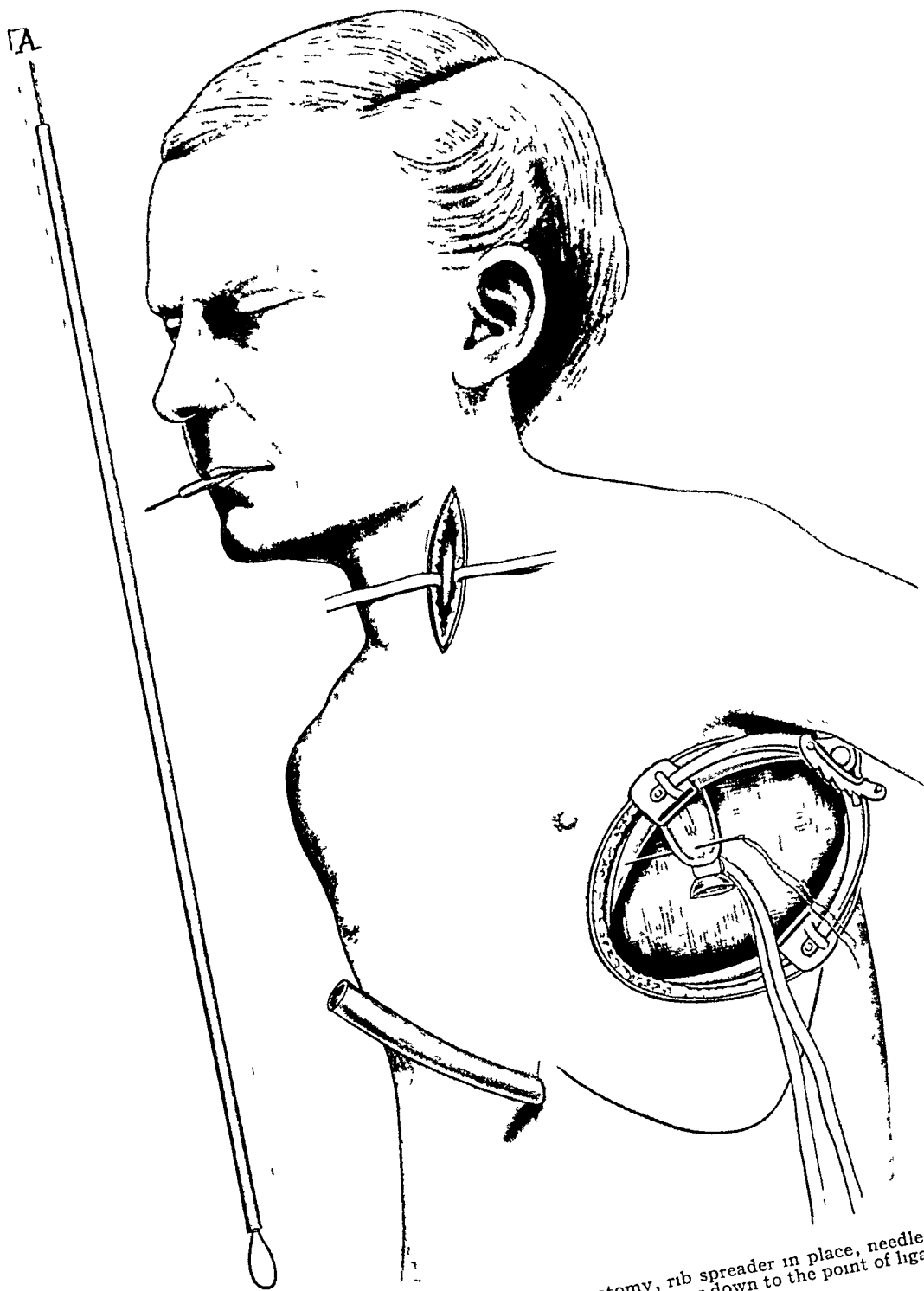


FIG. 17 — Thoracotomy added to laparotomy, rib spreader in place, needle with linen thread pierces the loop of the wire introduced by the narcotizer down to the point of ligation of the œsophagus. Abdominal incision outlined. Sound at left.

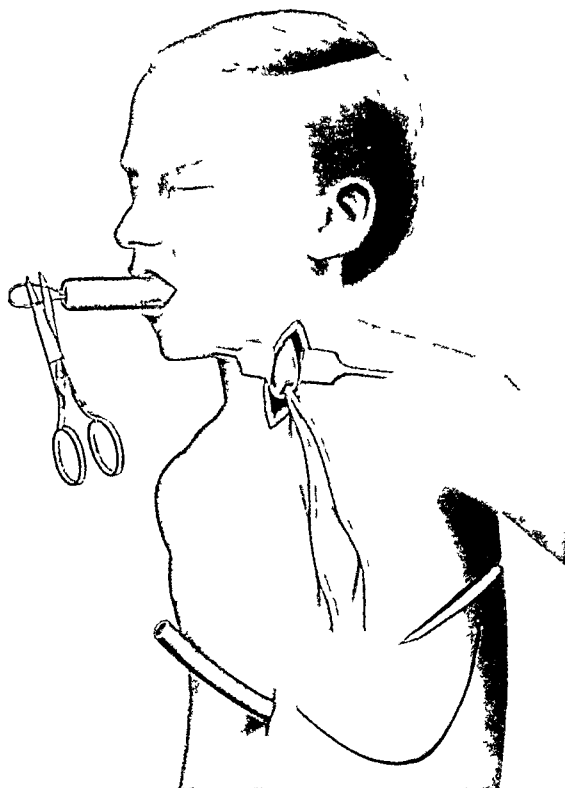


FIG 18 —Œsophagus everted extracted from the mouth of the patient by the narcotizer until the tape pulled up in the posterior mediastinum appears at level of the neck wound which is held apart by blunt retractors. The long ends of the piece of ligating tape are lifted out of the neck wound and placed on the chest. The thread in front of the mouth is divided with scissors by the narcotizer. Abdominal and thoracic wounds outlined.

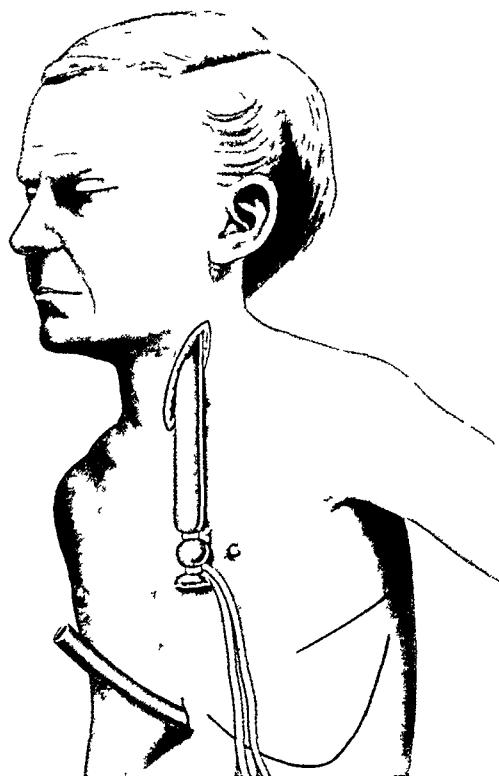


FIG 19 —The surgeon has by a gentle pull on the long ligature ends re everted the œsophagus which now hangs down on the chest wall. Abdominal and thoracic wounds outlined.

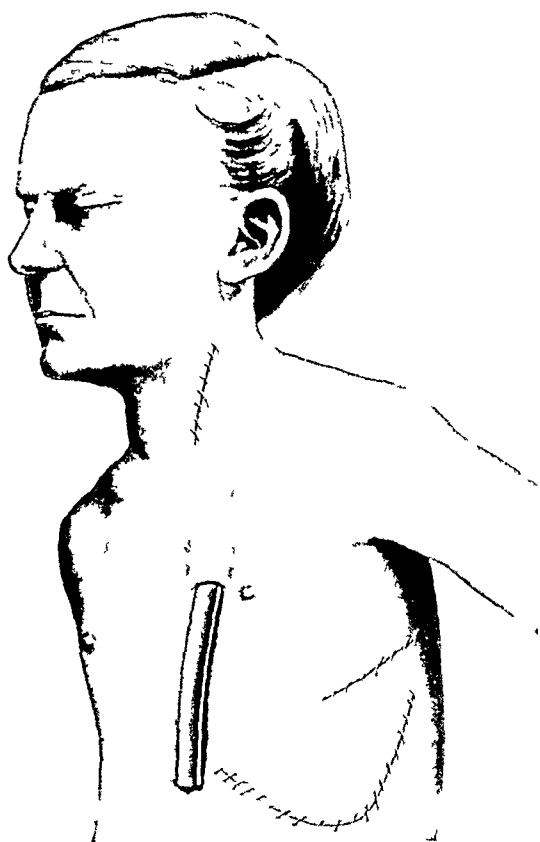


FIG 20 —Proximal stump placed under the skin tunnel of the chest, lower end opened stitched in place rubber tube shown, as it would have connected the lumen of the oesophageal stump with the gastric fistula (Gluck Perthes method)

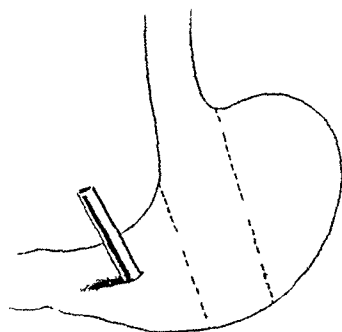


FIG 21 —Diagrammatic Emergency operation suggested by the accident that occurred By running a second line of transverse division on the other side of the oesophagus the latter could have been quickly lengthened by a piece corresponding to the transverse diameter of the stomach the closed major curvature being stitched in the abdominal wound to be opened forty-eight hours later Of course the entire cardiac pouch of the stomach is to be used and a short distance of the same sutured in the abdominal wound, if the surgeon has to break off the operation at this juncture



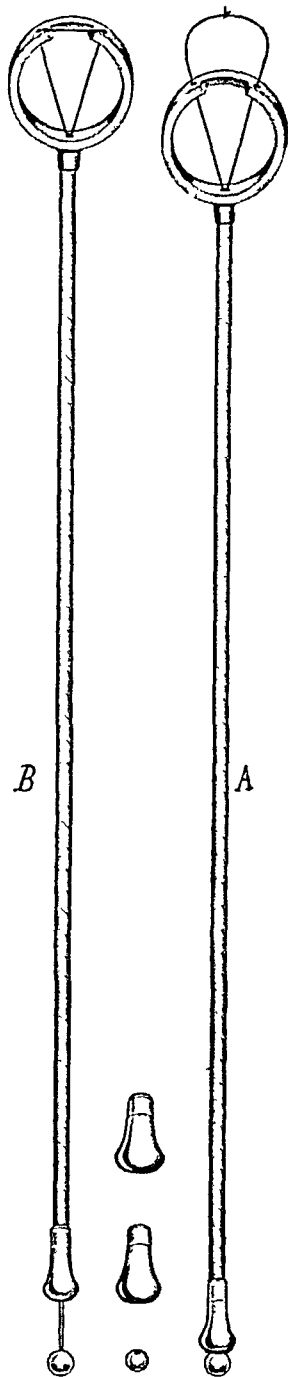


FIG 22 —Author's œsophageal extractor rendering the extraction an absolutely aseptic procedure *A* ready for introduction the perforated bullet is drawn up toward the sound's mushroom tip which has a rounded border *B* the bullet is milked down until it approaches the ligated stump of the proximal end Above it a tight ligature is then placed (see Fig 18 and 23 *D* and *E*) The separation of shot and mushroom can also be obtained by holding the shot and having the narcotizer pull the sound back.

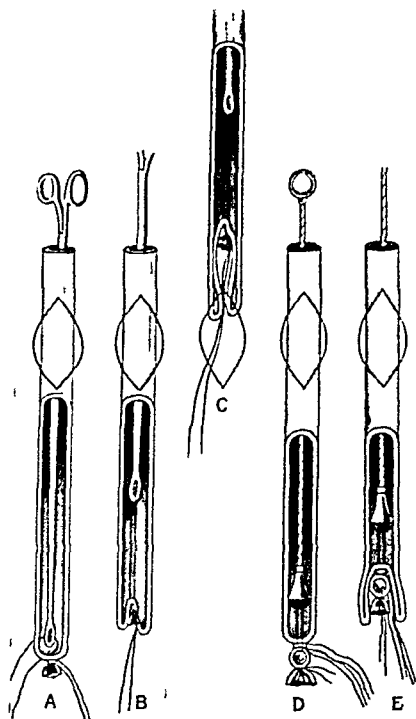


FIG 23 —Diagrammatic Showing œsophagus stump in course of extraction *A B* and *C* being done with Ach's wire extractor (taken from Ach's book) *D* and *E* demonstrating the procedure with the author's extractor The oval represents the neck wound which exposes the œsophagus In *D* and *E* the silk threads are shown by the artist to pierce the wall of the œsophagus the lower end of which harbors the perforated shot Of course they pass to the shot through the lumen of the œsophagus and do not pierce the œsophageal wall

placed at its middle by means of Huebner's large wire stitching instrument<sup>14</sup> A good-sized pouch was left in connection with the gastric fistula Division of stomach between the suture lines, inversion of the distal end by a running silk suture, straight clamp on proximal end of stomach Both pneumogastric nerves at and above cardia clearly visible, they were tightly attached to and surrounded by the tumor They were freed and cut through, curved clamp placed on œsophagus right above tumor, it furnished an additional good tractor Crushing and ligation of the œsophagus with narrow tape further up, and division of the tube between (Fig 12) This step finished the complete removal of the cardiac carcinoma (Fig 13) Sterilization of œsophageal stump with pure carbolic and alcohol Had I had Ach's wire with endloop (Fig 17 A) at hand, I might likely just have been able, by means of strong downward traction of the tumor while it was still in its normal anatomical relation to the cardiac portion of the stomach, to reach the healthy part of the œsophagus from below and pierce the loop on the lower end of the wire which is introduced into the closed œsophagus by the narcotizer, with a straight needle and silk thread (*cf* CASE II) I might also have been able to extract the proximal stump in spite of the still present adhesions But not having such a wire at hand, and the patient's condition at this time still being good, I had him turned entirely on his right side and added left thoracotomy in the seventh interspace (Fig 13 A) After placing the rib-spreader and after incision of the mediastinal pleura to the right of the descending aorta the œsophageal stump was immediately found and thoroughly freed I now had hoped to be able to extract the œsophagus without special difficulty through the œsophagotomy wound in the neck which had to be added, as I had been able to do in previous operations But this time, unfortunately, the œsophagus did not yield, it had gradually to be freed intrathoracically and first extracted from behind of and placed in front of the aortic arch (Fig 13 A), a difficult and time-consuming procedure through a straight intercostal incision without additional posterior division of ribs upward The field was away up and difficult of access But an additional bone operation I wanted to avoid at all hazards in order to reduce the severity of the complicated work And yet it might have been better for patient and operator had I quickly added a posterior cut upward and divided three or four ribs at their angle (Torek's incision) After the œsophagus had been brought in front of the aortic arch it yielded to the pull of the forefinger which had been put around

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<sup>14</sup> See Jour Amer Med Assn, January 10, 1914, pp 100-105

it in the neck wound. It was found that the mass ligature of narrow tape, which closed the lower end, had slipped off during this manipulation, spoiling the asepsis. Clinical observation must decide whether transverse perforation of the œsophagus with needle and thread (silk or linen), and using the latter for *safe* closure, viz., without the possibility of slipping off, and prompt, thorough iodination of this ligature, will disturb asepsis. If not, it will be *the* method of tying the œsophagus. The extracted œsophageal stump was now placed, as usual, under an antethoracic skin bridge and stitched in the transverse wound right above the third costal cartilage (Fig 13 B), the still tied end projecting for a short distance. Now the wounds in the neck, thorax and abdomen were closed by layer sutures, the pleural cavity having been drained through an incision in the ninth interspace<sup>15</sup> and dressings applied. The patient was placed under differential pressure for after-treatment, with his head in the positive cabinet which had recently been installed in the room for thoracic surgery at the Post-Graduate Hospital.

As was to be expected, the patient was in a state of profound shock, though his pulse was 108 after an intravenous infusion which had been given in the course of the latter part of the operation. Despite the use of all possible stimulants he died fifteen hours after the operation. No autopsy. Microscopic examination of the tumor (Fig 14) proved it to be an epidermoid (squamous-celled) carcinoma.

CASE II.—In the second case I planned to follow Ach's method more closely and therefore procured the wire with the endloop (Fig 17 A). Male, aged fifty-two years, patient of Dr G S King, of Bayshore, L I, who kindly referred him to me. Strong man, still weighs 200 pounds, having lost more than 30 pounds during the last few months, fluid food only passed down during the last three weeks. February 5, 1915. Callman's sound meets impassable stricture 38 cm from incisor teeth. Olive tip finds resistance at 40 cm<sup>16</sup>. X-rays demonstrate distinct stricture near

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<sup>15</sup> So far I have drained such thoracic cases in whom I considered drainage the best procedure for the patient on general surgical principles by retaining the patient under differential pressure at the close of the operation. (See ANNALS OF SURGERY, July, 1912.) Of course, the problem of effective drainage after a thoracotomy, which involves the avoidance of a post-operative acute pneumothorax, may be solved in many ways without the use of cabinet or chamber (Cf Tiegel, *Langenbeck's Archiv f klin Chir*, vol xciii, p 311, and Kenyon's method Johnson *Oper Therapeutics*, vol 1, p 242.)

<sup>16</sup> The obstruction, made out by a sound, means the point of greatest contraction in the course of a malignant stricture, not its upper end, while the tumor may cover quite some length of the tube.

## RESECTION OF THE CARDIA FOR CARCINOMA

cardia Oesophagoscopy (Dr Yankauer) February 11, Witzel's gastrostomy, at German Hospital Palpation shows a hard movable tumor above cardia in region of oesophageal hiatus, cardia not involved, enlarged glands in lesser omentum, stomach small Forced nourishment, with full diet, properly chewed and deposited in warm fluid and injected into stomach with large hand syringe through gastric tube

In view of the obstruction having been made out 38 cm down, which meant that it might be impossible to reach the healthy portion of the oesophagus by way of the abdomen, it was proposed to the family that the operation be done in three stages, viz Stage 2 thoracotomy, division of oesophagus sufficiently above tumor to insure safe inversion of tied distal end, antethoracic transposition of proximal stump, thoracic drainage Stage 3 removal of tumor from an abdominal incision after transverse division of stomach The family was rather opposed to such division of the work, clearly indicated as it seemed to me, and they pleaded for a final second stage I yielded to their wishes, hoping that I yet might be able to extract the oesophagus according to Ach, working from the side of the abdomen only

*Radical operation* (March 18) —First assistant, Dr Rehling, intratracheal insufflation (Dr Sanford) Patient bears this kind of anæsthesia very poorly, large amount of anæsthetic required before reflexes cease, persistent cyanosis in spite of carrying out insufflation properly in every detail Preparation of patient as above described, incision at neck, oesophagus loosened and surrounded with tape, loose tamponade Abdominal incision as in Case I Parts not well accessible Increasing lordosis makes little difference Therefore additional division of left seventh costal cartilage near sternum, and eighth, ninth and tenth ribs in axillary line (Fig 15) With a costal arch—rib flap thus formed and pulled up, good access is obtained Circumcision of foramen oesophagæum, dividing diaphragmatic peritoneum and—bluntly advancing—freeing oesophagus all around, adhesions posteriorly very tight On traction downward the oesophagus yielded but very little The finger found oesophageal infiltration away up as far as it could reach, making it plain at once, much to my dismay, that thoracotomy would again have to be added in the same sitting, as in Case I Gradual mass ligature of either omentum, there was a broad posterior adhesion of the stomach, which made work rather difficult, cardia surrounded and lifted up with a piece of tape

On dividing the stomach, which had an unusually distended cardiac pouch, with Hueltl's large wire-stitching instrument, a

peculiar accident occurred, which, I feel, I ought to mention. A transverse division of the stomach, not far to the right from the cardia, which as such was found healthy, had been prepared for. The instrument was properly placed in position, then closed and clamped as usual, while the second assistant supported the cardia with the tape loop and the first assistant took hold of the end of the instrument within the abdomen. After cranking and opening it under the costal arch, it was found that the cardia, evidently at the last moment, had been inadvertently withdrawn from the grasp of the instrument, most likely by an unintended pull upon the tape held by the second assistant, who could not see the field of operation. This is possible, as "the Hueltl" has one single big blade, more than one inch wide, which, after closure, takes hold of the intestine, crushing the centre of the part it has in its grip<sup>17</sup>. Thus the upper end of line of stomach division passed the cardia close to its left instead of its right side (Fig 15, small picture, line *B*), cutting off the stomach pouch lying to the left of the cardia (see Fig 16 *B*). A second division of the stomach nearer to the pylorus had therefore to be done (Fig 15, small picture, line *A*), and all three lines of incision closed with needle and thread, a rather irksome procedure. Tumor, with the closed stomach pouch attached, was now pushed through foramen œsophagæum into the posterior mediastinum above the diaphragm and a gauze tampon inserted on top to keep it there. Four temporary sutures in wound of abdominal wall. Lateral posture increased. Thoracotomy in seventh intercostal, lung nowhere adherent. Mediastinal pleura incised near aorta, pleural wound bluntly enlarged, tumor dissected and lifted up with attached stomach pouch, it was wrapped in gauze. Adherent pneumogastric nerves divided. Œsophagus crushed and tied within healthy tissue with a piece of narrow tape which was left rather long (Fig 17), curved clamp placed distally, division of œsophagus with knife, therewith excising the tumor of the cardia (Fig 16), disinfection of the stump with carbolic acid and alcohol. Introduction of wire loop (Fig 17 *A* and Fig 23 *A*), by narcotizer (the same can be well felt by the surgeon's fingers), piercing of loop with needle and thread (Fig 17), which latter is left about 4 to 5 inches long, ends knotted. Extraction of œsophagus (Fig 23 *B*), method works admirably. It is seen that tube is nicely inverted (Fig 23 *C*). As soon as the tapes appear in the neck wound which was held well apart (Fig 18), the narcotizer cut the silk thread in front of the inverted œsophagus (mucosa outward), the lower end of which naturally had ap-

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<sup>17</sup> See Jour Amer Med Assn, 1914

## RESECTION OF THE CARDIA FOR CARCINOMA

peared in front of the mouth. With gentle pull on the thread in the neck wound, it was easily re-everted and slipped downward on the chest (Fig 19). The whole procedure impressed me and everyone present as a most useful, gentle and ingenious method of transposition of the oral stump of the œsophagus, no matter how long. Transverse skin incision over third intercostal space near sternum, skin tunnelled and œsophagus placed subcutaneously (Fig 20), tip being left unopened, somewhat projecting. Layer suture of neck and thoracic wound, drainage of pleural cavity, suture of foramen œsophagæum and diaphragmatic peritoneum from below, and of abdominal wound. While we were busy with the latter work, the narcotizer reported inability to make out patient's pulse, strong stimulation, operation completed. When insufflation was stopped, there was no spontaneous respiration nor heart-beat. Insufflation had kept the lungs distended and collapsed, but the centres in the medulla had died and could not be resuscitated.

I believe that the difficulty experienced with insufflation—the patient remained cyanotic throughout the operation—had something to do with the fatal issue at the end of the work. In future I shall stop operating and continue at a later date, if proper ventilation of the lungs cannot be established. Of course, it may be a difficult matter for the surgeon to discontinue in the course of an operation of this kind.

This case teaches that the operation should be a three-stage one, if the cancerous infiltration is likely to involve a greater portion of the intrathoracic tube, so that the healthy part of the œsophagus cannot be safely reached from below. The extensive invasion of the abdominal plus thoracic cavity at the same sitting is clearly too much for these weakened individuals. But, I believe, *the aim* must be in resection of the cardia for carcinoma, to extract the œsophagus according to Ach, avoiding a transpleural thoracotomy, and thus get through with the extirpation of the growth *in one sitting*.

On pondering over the accident recorded above and illustrated in Fig 15 (small picture), I regret that I did not break off the operation right at that point. Had I at this moment decided to do a three-stage operation and at once made a second transverse incision through the stomach to the right of the cardia, the œsophagus would have been lengthened by a continuous organic tube corresponding to the transverse diameter of the stomach (Fig 21). The lower end of this new tube, represented by the major curvature, could have been stitched in the abdominal wound, slightly projecting, and opened after forty-eight or sixty hours, the patient being meanwhile fed through the gastric fistula.

When removing the tumor radically in the third stage, the part could then have been easily dissected from the abdominal wall, the opening inverted and the mass excised in an aseptic manner. This is said under the assumption that the arterial blood passing from the œsophagus past the tumor on to the stomach would have sufficed to nourish the artificial organic extension of the œsophagus. It will be remembered that both omenta with the main arteries for the cardiac portion of the stomach had been tied off primarily in order to mobilize the lower end of the œsophagus, which proved to be a difficult proposition without such ligation on account of lack of room, a trouble which seemed to depend mainly on the presence of the gastric fistula. To meet emergencies in the course of resection of the cardia it certainly seems best to follow Ach and ligate the omenta *after* the division and extraction of the œsophagus, provided this is technically feasible.

An objectionable feature of the way Ach goes about the extraction is piercing of the œsophagus with needle and thread and pulling on the thin wall of the œsophagus by means of the latter. In the case reported I have seen a tear, one-eighth of an inch in length, of the wall of the œsophagus, made by the thread. Piercing the œsophagus may, furthermore, hurt asepsis. Ach believes he can avoid infection by starting the extraction the moment the penetrating thread has been tied. But does this really avoid it? Better, certainly, had the œsophagus been left intact.

From these considerations has the extractor been conceived which is shown in Fig 22, and the process of extraction in Figs 23, *D* and *E*. This extractor consists of a somewhat modified Callman sound and a heavy piece of shot, perforated and suspended, like a bead, on a silk thread, which is passed through the hollow stem of the sound. The suggestion to place the thread within the stem came from Dr S Yankauer, to whom I showed my sketches after I had discussed them before the Clinical Society of the German Hospital, on April 9, 1915. The doctor also kindly directed for me the manufacture of the first instrument.

The extractor is introduced with the shot pulled up snugly against the mushroom (Fig 22, *A*) and is pushed forward to within a few inches of the ligature, closing the oral stump. The shot, which can be clearly felt through the wall of the œsophagus, is then milked down close to the ligature (Fig 22, *B*). The œsophagus is next ligated between shot and mushroom by means of a tight tape-ligature (Fig 23, *D*) and now extraction begun (Fig 23, *E*), the mushroom opening the way for the ligated end of the stump and the pull being on the shot and the

## RESECTION OF THE CARDIA FOR CARCINOMA

taped œsophagus (In the illustration the œsophagus above the mushroom should have been shown collapsed )

I have tried the instrument in a dog, where it worked very well. There is no reason why it should not work equally well in the human subject. In case of emergency, an ordinary œsophageal sound with olive tip might, of course, be used.

Reviewing the technical aspect of resection of cancer of the cardia, or, in fact, of cancer of any other part of the œsophagus, it seems to me that the present status holds out well-grounded hope for the possibility of doing more frequently successful work, than has been seen so far.

A further point, essential for a more frequent successful issue of resection of the cardia, is early diagnosis<sup>10</sup>. The fulfillment of this requirement lies to a great extent in the hands of the general practitioner who usually sees these patients first. Knowing the mortality of expectant treatment to be 100 per cent and almost as high following operation when delayed too long, he must learn to consider a patient who complains of difficulty in swallowing *a surgical case*, just as he now regards acute appendicitis as a clearly surgical trouble. Of course, the blame for the unfortunate delay does not always rest with the general practitioner. Not infrequently the patient does not call for medical advice until months after the onset of the trouble. Still, the ever-recurring and increasing obstruction to normal swallowing usually worries him, and in the majority of cases he will ask for medical aid at a time when the surgeon could still bring real help by a radical extirpation.

It is conceivable that a certain percentage of very early cases of cancer of the œsophagus or cardia could be benefited by intra-œsophageal treatment with radium. The majority of these tumors are of the squamous-celled type, which corresponds to the epithelioma of the skin, a disease which in many instances yields so beautifully to radium. And this is a clinical fact of which I could personally satisfy myself in quite a number of my patients. Of course, the œsophagoscope must corroborate the local change for the better, if gradual improvement of the obstruction to swallowing should point to an effectual result of the radium treatment. For it must not be forgotten, that improvement in the act of swallowing is frequently observed in these patients when nothing at all was done. It certainly will be of importance to have some of these cases submitted to radium rays at the hands of experts, and to have their clinical findings carefully recorded and final results demonstrated.

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<sup>10</sup> See author, "The Early Diagnosis of Cancer of the Œsophagus," Amer Jour Surg, July, 1915



Personally, I fear that a *radical cure* will be achieved in very few cases, if at all, and that by such attempts the best time for operation will be lost. Furthermore, the possibility of a perforation by a radium burn must be considered. So far no case has been recorded in which an œsophageal malignant tumor was *permanently* benefited by radium. Until such positive results can be shown it remains, of course, our solemn duty, to consider *all* these patients *operative cases*, and that at as early a date as possible. The cylinder-celled carcinoma which takes its origin from the epithelial cells of the mucous glands of the œsophagus and often involves several inches of the tube will most likely not yield to radium, and therefore remain permanently and wholly under the domain of operative surgery. Dr M. Emhorn, of New York, was the first to write on this subject years ago (*N Y Med Record*, March, 1904, and *Journal A M A*, July, 1905). At present a number of American colleagues are at work in the same direction. It would be most gratifying if they succeeded.

Let us all, then, in word and print, again and again, emphasize the importance of the dictum. A patient with difficulty in swallowing that came on gradually, without apparent cause (burn, etc.) needs a strict diagnosis at once. This is best done in a modern, well-equipped hospital. If suspicion of malignancy exists, the case is to be considered a surgical one immediately.

Of course a large number of doubtful points remain to be cleared up, some of which may take many years for their definite solution. I will mention here only a few.

Is primary gastrostomy as the first stage absolutely necessary? Could the gastric fistula not be established after the excision of the tumor at the same sitting, viz., the entire work be done at one stage? A series of animal experiments in which thoracotomy with division of both pneumogastrics plus gastrostomy were done at the same sitting, might help to solve this question. In other words, it remains to be shown whether primary double division of the pneumogastrics within the thorax or at the cardia really is the cause of leakage of the gastric fistula (observation by Ach and by author, each one case).

Can we get sufficient access to the vault of the diaphragm without an additional bone operation, in the presence of a gastric fistula? It has seemed to me in the course of the second operation, that the division of a fascia band, near the tip of the eleventh rib, suddenly gave much better room. Special attention should be paid to this point. It is possible that similar fascia conditions exist in front, as W. J. Mayo found in his incision for operations on the kidney below the twelfth rib.

## RESECTION OF THE CARDIA FOR CARCINOMA

How long may be the transposed proximal stump of the œsophagus without becoming necrotic? By what means can we prevent necrosis at the distal end?

Should, for the purpose of extraction, the nervi vagi better be dissected off the œsophageal wall and left intact, like guides on either side of the tube? It is plausible that in the presence of firm adhesions alongside the œsophagus one of the nerves might be torn out if divided near the cardia before the extraction.

In view of the fact that excision of the malignant tumor is the main object of the work, is it wise or permissible to make it the third stage of the operation?

What we must not forget, is, that we are only just entering upon this new field of operative surgery. However, a start has been made, and the right start at that, it seems. The sooner the work is more generally taken up, the more rapid will be its advance.

Let us then remember that we have to-day at our command not only the mechanical means enabling us to combat the present difficulties and dangers of the operation, but also a proper plan of procedure. Let us remember, also, that the possibility of early diagnosis of cancer of the œsophagus promises to be soon an established fact in the hands of experienced specialists. It has been shown that successful excision of cancer of the cardia is possible. Hence we no longer have the right to declare a patient inoperable simply because his tumor happens to have developed at the cardiac instead of the pyloric portion of the stomach, thus condemning him to a slow death, connected with untold suffering.

In other words, we must bear in mind that it is not the location of the tumor that decides its operability or inoperability, but the actual pathologic condition in the vault of the diaphragm. And this can be determined only by the palpating hand of the surgeon.

# OBTURATOR HERNIA

WITH REPORT OF CASE

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MUMFORD states that about 200 cases of obturator hernia have been reported in surgical literature

Meyer, reporting 6 cases from the Leipzig clinic, states that 51 cases had been previously reported since 1875

Grasser has compiled statistics covering 118 cases in a period extending from 1720 to 1890

In view of these facts, we venture to report our case, trusting that the condition is rare enough to justify reporting

*Occurrence*—The greater number of reported cases have occurred in elderly females Seventy-nine per cent of Meyer's cases occurred in women over 60 years of age and the statistics of other authors agree with his

Most of the cases give histories of considerable emaciation following obesity

Meyer has drawn some conclusions regarding the etiology of obturator hernia from these facts They are as follows

First, obturator opening relatively larger in women than in men

Second, frequent pregnancies cause laxity and folding of the peritoneum, which may project through the opening

Third, emaciation removes the normal cushion of fat and renders the opening more easily penetrable

Fourth, subserous lipomata, which often coexist with this form of hernia, may be responsible for the origin in some cases He adds that views concerning the origin of obturator hernia have never been uniform

*Types*—Lejar described three types of this condition

1 Type traversing the entire length of the obturator canal from behind forward emerges from the anterior orifice and spreads out in front of the external obturator muscle and under the pectineus

2 Emerges between the upper and middle fasciculi of the external obturator muscle and becomes encircled and constricted by double muscular band

3 Hernial sac burrows from above downward between the two layers of the obturator membrane and remains entirely behind the external obturator muscle. On opening the pectineus, no hernia presents itself and a second muscular plane must be incised before the sac is found. Other difficulties are caused by the inconstant relationship of the obturator artery and its branches to the neck of the sac.

*Diagnosis*—Diagnosis is extremely difficult. Mumford states that operation has never been performed up to the present time except for strangulation.

1 With the pelvis elevated and the thigh flexed and moderately abducted, the hernia may occasionally be recognized as a prominent swelling in the upper part of the adductor region to the inner side of the femoral vessels. Often, however, the swelling is small and little apparent and only a diffuse asymmetry can be discerned.

2 Localized pain may be elicited by pressure at the inner part of Scarpa's triangle near the pubic spine. If the pain radiates definitely down the inner side of the limb to the knee the diagnostic value will be increased. This is called Romberg's sign and is due to compression of the obturator nerve. It is rarely absent.

3 The entrance to the obturator canal is accessible to vaginal palpation in the female and localized pain or a characteristic swelling or tense band may sometimes be recognized by this means.

This may also be demonstrated by rectal examination in the male.

Meyer very sensibly remarks that diagnosis, at best, is only a probable one and that operation should therefore be early.

*Operation*—Lejar advocates the following procedure.

First, pelvis raised by thick pillow or sand bag, thigh flexed and moderately abducted, recognize femoral artery and make 5-inch vertical incision one and one-half inches inside of it, beginning one inch below pubic spine.

Second, incise skin, subcutaneous tissue and deep fascia. Avoid the internal saphenous vein or divide it between ligatures. Recognize fibres of adductor longus running obliquely downward and outward and fibres of pectineus along its outer border. Protect great vessels with large retractor and open space between adductor longus and pectineus with grooved director or finger. As the pectineus covers the obturator opening it must be freed and retracted sufficiently to give good exposure. If necessary, a transverse incision may be made in its fibres or it may be detached partially from the horizontal ramus of the pubis in cases where access is difficult.

Third, herniæ of the ordinary type will now be plainly visible and

the sac may be isolated up to its point of emergence. In type two carefully divide the upper portion of the muscular band.

In type three the hernia will be beneath the obturator muscle and this must be freely opened by separation in line of fibres or free division.

Fourth, after freeing sac, open by a careful incision, making sure by palpation and inspection that no aberrant artery runs over the anterior surface. Try to free neck by stretching downward and inward with tip of index finger. In case this cannot be done bear in mind the following facts:

(a) Constriction is always due to edge of obturator membrane external to sac.

(b) Draw sac aside, seek extravascular zone by palpation, or make sure of position of obturator artery and branches. Make two or three very cautious nicks under direct inspection and complete by stretching with finger. In case the neck is surrounded by a complete arterial ring make incision between two pairs of hæmostats applied high as possible.

Fifth, extract, inspect and, if necessary, repair herniated bowel.

Ligate sac and, if possible, close anterior orifice of canal by a few sutures.

Lejar strongly emphasizes the dangers due to the vascular relations in these cases. While in the ordinary type of hernia the artery and nerve are usually behind the neck of the sac and a little to its outer side, the artery has been found on all sides of the sac and the neck has been found surrounded by a complete arterial circle. Consequently, the freest possible access should be provided, the neck of the sac clearly exposed, the position of the neighboring arterial branches ascertained by inspection and palpation, and ample room provided for adequately dealing with hemorrhage in case a large vessel should be wounded in spite of all care. He also mentions the abdominal operation, saying that it usually permits of more easy reduction and avoids the vascular dangers. However, he says that extreme caution is necessary to prevent peritonitis from septic sac contents. While the sac cannot be excised by the abdominal route the neck can be closed by a few sutures.

Meyer advocates the abdominal operation, citing the following advantages:

- 1 Better view of field of operation
- 2 Reduction facilitated
- 3 Intestinal resection can readily be performed, if necessary

## OBTURATOR HERNIA

Mumford suggests the advisability of opening the abdomen from above after isolating the sac and freeing the neck. This would give advantage in making any necessary repairs on the bowel and would also permit of ligation and removal of the sac. He says results have been unfavorable in this operation because of the difficulty in adequately treating the herniated bowel through the obturator opening.

*Mortality*—Grasser's statistics showed a mortality of  $78\frac{81}{100}$  per cent in 118 cases. Meyer had a mortality rate of 54.27 per cent, Levit had a mortality rate of 50 per cent in four cases. The fact that many of the patients are elderly women in a poor state of nutrition partly explains the high mortality, also many operations are performed late due to diagnostic delays.

**CASE REPORT**—J. L. S., male, aged sixty-five years, farmer, entered Tennessee Copper Co. Hospital at 1 P. M. June 27, 1915, referred by Dr. J. M. Daves, of Blue Ridge, Georgia. History of complete intestinal occlusion since June 19. Said he had been troubled by a hernia for four years and it "caught on him" June 19. Claimed he could feel the hernia slip out and could usually get it back, but on this occasion he could not do so.

Pain and shock at first, afterwards complete constipation and profuse vomiting. Operation urged by Dr. Daves and consultant, Dr. Tankersley, of Ellijay, Ga., when they saw patient on June 20.

Patient steadily refused until June 27. No flatus passed with numerous enemas.

*Examination*—Temperature  $99\frac{2}{5}$ , pulse 104, regular and full, white blood count, 10,000, urine negative, abdomen not much distended, large right-sided hydrocele, inguinal and femoral canals apparently normal, no fulness in right obturator region, although patient was considerably emaciated and palpation facilitated.

Romberg's sign present and a peculiar tense mass could be made out on rectal palpation, general condition seemed excellent under the circumstances.

The patient was positive of the existence of a hernia which he was ordinarily able to replace by manipulation and he referred its location to the obturator region. However, he claimed that he had derived benefit from a truss bought and fitted by himself which did not coincide with our ideas of obturator hernia. Obviously, an immediate operation was imperative, so he was prepared at once.

*Operation*—Ether anaesthesia, iodine preparation. We decided to at first explore the inguinal and femoral region through

a Bassini incision and if the source of trouble was not found to make an abdominal section. Rapid Bassini exploratory incision revealed right inguinal and femoral regions normal, so abdomen was opened in median line. Small intestine was found distended, cæcum collapsed, coil of small intestine found incarcerated in right obturator opening and held under considerable tension. Cautious examination showed the incarceration very firm and, as it had existed eight days, it was deemed advisable to open the obturator region and fully free the sac as a preliminary to reduction. The pectineus muscle was exposed by the usual vertical incision inside the femoral artery and its fibres separated. A hernial sac was found rather small and tightly bound down by numerous tough adhesions.

The sac was thoroughly freed by blunt dissection and, when it was held up for inspection preparatory to opening the herniated bowel, reduced itself. The end of the sac was secured by a forceps and the bowel inspected through the abdominal opening. There was no evidence of circulatory impairment and the condition seemed excellent except for a few abrasions of the serous surface near the mesenteric border. These were repaired by silk Lembert sutures.

The obturator opening was examined and the sac was found empty.

The opening barely admitted the tip of the index finger. The abdominal incision was closed. The sac was then ligated and cut off high up and the obturator incision closed. The condition of the patient seemed very good, so the right testicle was brought through the inguinal incision and the hydrocele quickly operated by the eversion method of Jaboulay. The inguinal incision was closed and the patient left the table with no evidence of shock and in very satisfactory condition.

*Subsequent Course*—Gas was passed freely a few hours after the operation and excellent results obtained from an enema the following day. Recovery was absolutely uneventful and the patient protested vigorously against the cautious administration of liquid nourishment during the first few days of his convalescence. He left the hospital July 15, in excellent condition.

#### CONCLUSIONS

First, the difficulties attending diagnosis of obturator hernia are well illustrated in this case. In spite of the fact that this patient gave a clear history of hernia referred to the obturator region and that his emaciation facilitated palpation, a positive diagnosis could not be made without abdominal section.

## OBTURATOR HERNIA

Second, in view of the difficulty of positive diagnosis and the difficulty of exposing the obturator region by dissection, a preliminary median abdominal laparotomy seems a very sensible procedure in suspected cases of obturator hernia. It has the following points of advantage:

(a) The diagnosis is cleared up at once.

(b) The possibility of making an exposure of the obturator region only to find no hernia there is avoided.

(c) The abdominal incision greatly facilitates any necessary repair of the herniated intestine.

(d) In cases where the condition of the patient demands quick work, the hernia can be reduced from within the abdomen, relieving the constriction under direct inspection with the patient in the Trendelenburg position. The obturator opening could then be closed by a few sutures from within.

(e) When the patient's condition permits the obturator region can be exposed and the sac dissected free and ligated. Inasmuch as it establishes diagnosis at once and facilitates subsequent operative procedure, preliminary laparotomy seems extremely rational.

Third, the modern system of prompt laparotomy in the early stages of all cases of intestinal occlusion will, no doubt, very much lower the mortality rate in future cases of obturator hernia.

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## THE PROSTATE GLAND IN OLD AGE

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THIS report concerns the anatomical structure of the prostate gland in old age. Seventy-one specimens varying in age from sixty-two to seventy-nine years have been studied. Observations of the gross specimens have been carefully made. Sections taken from various parts of the gland have been cut and stained in the usual manner and studies have also been made of complete serial sections of the entire organ from its apex to the base and also include the vesical sphincter and the entire trigonum vesicæ. In staining these sections various dyes have been used. Most of them have been stained with hæmatoxylin and eosin. In a large number of instances Van Gieson's stain for the differentiation between smooth muscle and connective-tissue cells has been utilized as well as Weigert's elastic tissue stain.

It seems appropriate to review very briefly the embryology and anatomical changes in earlier years before taking up the discussion of structural changes in old age. As has been pointed out in a previous communication, the prostate originates from five independent groups of tubules which begin to develop in the wall of the posterior urethra at about the twelfth week of intra-uterine life. (a) The middle lobe is usually made up of about nine or ten tubules originating on the floor of the urethra between the bladder and orifices of the ejaculatory ducts. There may be an absence of the middle lobe, in which case there is an ingrowth of tubules from the lateral lobes. (b) The posterior lobe is an independent structure, being made up of twelve tubules which originate from the floor of the prostatic urethra below the orifices of the ejaculatory ducts. They grow posteriorly behind the latter structures and are in no sense a glandular commissure, as they are definitely separated from the other parts of the gland by a lamella of connective tissue. (c) The anterior lobe is fairly large until the sixteenth intra-uterine week, after which it seems to decrease in size and importance. At birth it is very small.

The so-called accessory or contiguous structures are interesting, and as their development and later changes are quite important they will be briefly mentioned.

The subtrigonal mucous glands are noted as early as the twenty-

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second week of intra-uterine life and are comparatively few in number, the average in all embryological specimens studied being six

The subcervical glands of Albarran occur in all specimens older than the fifteenth week of intra-uterine life. They average twelve in number during this period.

The seminal vesicles originate at the thirteenth week and appear at first as an evagination lateralward from each vas deferens. They grow backward and laterally, consisting of a main part which is convoluted and from which rather numerous, short, convoluted branches grow out, as described by Pallin.

The vasa deferentia and ejaculatory ducts are at first exceedingly large, comparatively speaking. Later on, as the embryo becomes more mature, they are outgrown by surrounding tissues and hence are comparatively smaller. As these structures approach the lumen of the urethra its floor is pushed up into a mound, converting it into a semi-lunar-shaped passage and forming the verumontanum.

Before the fifth month the utricle in nearly every instance extends to the base of the prostate. After that age it is usually found in the tip of the verumontanum.

In the wall of the urethra just at the apex and a little below it there are found in the older specimens delicate tubules with a few branches. They are not connected with the prostate and extend only slightly into the muscular walls of the urethra. They disappear lower down in the urethra.

In early embryonic life the peritoneum covers the posterior surface of the prostate and seminal vesicles, extending as far as the apex of the former. Later on this peritoneal sac becomes pinched off, as is beautifully shown by several of Dr. Franklin P. Mall's specimens, and has been described by a French writer, Denonvilliers, whose name the resulting fascia bears.

In old age the prostate lies behind the second portion of the rectum at the neck of the bladder, which it surrounds posteriorly and laterally. It is firmly attached to the vesical orifice and urethra and is encircled by the prostatic fascia. It is held in position by several structures. Its apex is suspended superiorly by the puboprostatic ligament which connects it with the pubic bone on either side. The anterior surface is separated from the symphysis pubis by a space 1.5 cm. to 1.1 cm. in size and gradually increasing from above downward, filled chiefly with a fatty cellular substance and a dense venous plexus. Inferiorly it is joined to the rectum by the recto-urethralis muscle, which is a reflection of the anterior portion of the levator ani muscle. The deep layer of the

triangular ligament aids in fixing the apex because it invests the membranous urethra and is attached to the prostate. The lateral borders of the gland are embraced by portions of the levator ani muscle, which are separated from direct contact with it by a plexus of veins.

The shape of the prostate changes markedly during various stages in its development. At the very first appearance during the latter portion of the third intra-uterine month it exists as a cylindrical mass surrounding the posterior urethra, the mass being a little more pronounced on its posterior aspect. About the seventh month the lateral borders near the base become quite bulging in character, due to the fact that the lateral lobe tubules grow more extensively than do those of other portions of the gland. At the time of birth the gland is slightly more flattened than during the seventh month and also a little larger. Between the time of birth and the beginning of puberty there is very slight change in the shape of the organ. During the adolescent period the prostate changes markedly. It loses most of its rounded appearance and rapidly assumes the appearance of the adult organ. The length of the prostate in every instance is greater than its thickness and always less than its width.

In shape the adult prostate has often been likened to a horse-chestnut flattened on one side, but this comparison seems to be insufficient. Its posterior surface is triangular and flattened. It usually has a depression extending longitudinally in its midline which is most prominent towards the base of the gland and rarely, if ever, exists at the anterior one-third. Its upper border or base bulges on each side as do the lateral borders. The anterior surface is rounded and most of the vessels of the prostate occur here and at the lateral borders, very few being found on the posterior surface or at the base. The base receives the ejaculatory ducts after the junction of the vasa deferentia with the seminal vesicles in an elliptical funnel-shaped depression. Geometrically the prostate has been called an oblate conoid or truncated cone.

The size of the prostate shows marked changes at various stages in its development, as is shown in the accompanying table. The development from the actual period of origination until the time of puberty seems to be upon the whole a fairly regular and gradual increase in size. At five years of age the gland is surprisingly little larger than it is at birth. The average length during the first half of the first decade is 1.2 cm. The width is 1.5 cm and height 0.9 cm. Cuthbert S. Wallace states "at the eighth year the prostate has increased somewhat in size, and taken on more or less the adult form. In regard to its

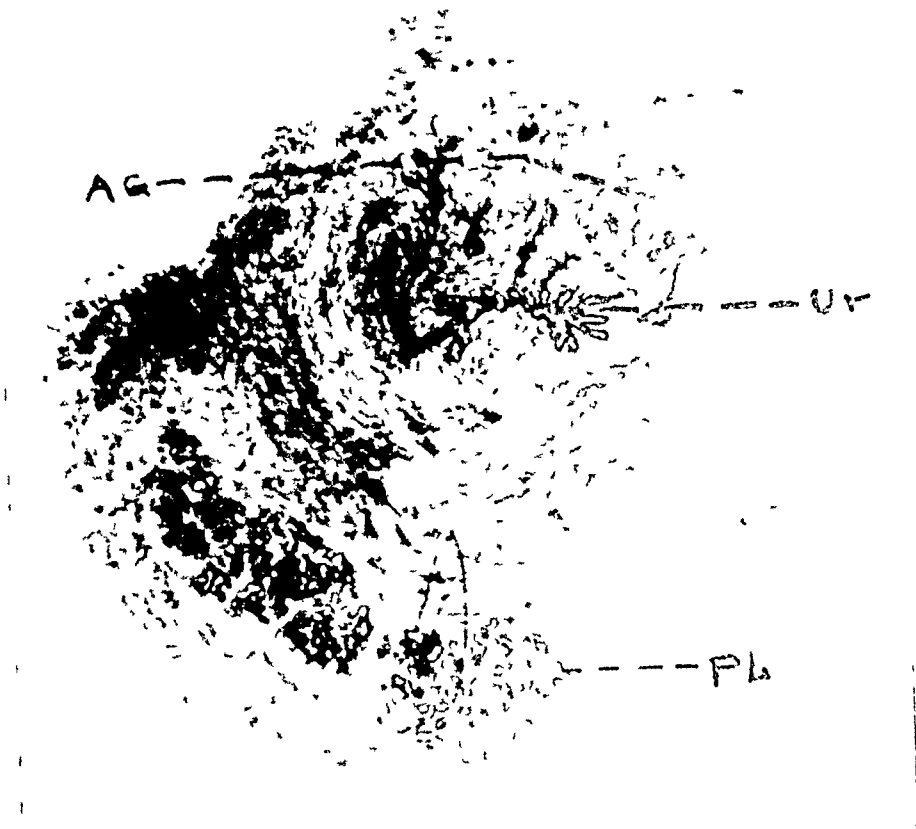


FIG 1—Cross section through urethra at apex of prostate showing tubules of the apex group, PL forward branches of the posterior lobe of prostate, Ur urethra, AG tubules of apex group of glands. Specimen seven and ten years of age.

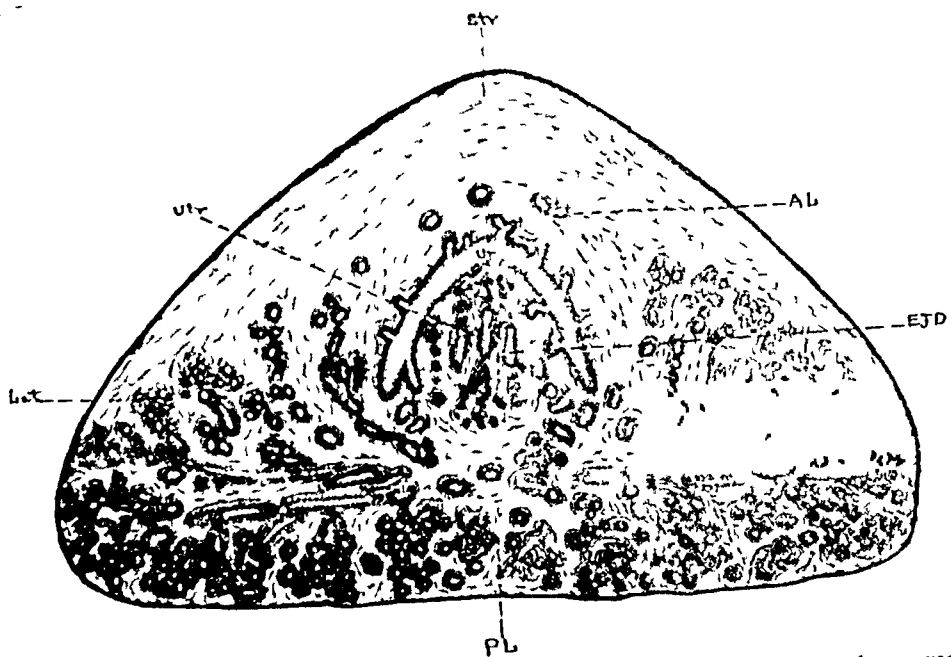


FIG 2—Cross-section through middle of verumontanum and prostate of a boy aged four years, stained according to Van Gieson's method. Ur urethra, Utr utricule, EJD ejaculatory ducts, Str striated muscle fibres, AL, anterior lobe tubules, Lat lateral lobe tubules, PL, posterior lobe tubules.



FIG 3 —Oblique section through the prostate trigonal region of a man aged seventy six years  
*Ur* urethra *AG* Albarran's subcervical gland tubules *VS* vesical sphincter *ML* middle lobe  
 tubules *EJD* ejaculatory ducts and muscular envelope *PL* posterior lobe tubules, *Lat* lateral  
 lobe tubules



FIG 4 —Cross section at the level of the region just above the upper end of the verumontanum  
 of a man thirty four years of age (section cut slightly obliquely) *Ur* urethra and portion of bladder  
 lumen *AG* Albarran's glandular tubules, *ML* middle lobe tubules, *Lat* lateral lobe tubules, *PL*  
 posterior lobe tubules *Utr* utriculus prostaticus and ejaculatory ducts bound firmly together in  
 envelope

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increase in size, there does not appear any increase in the glandular elements. At eighteen years the organ has increased in size, but the glandular elements are but scantily developed. Between twenty and twenty-five years the prostate is fully developed and becomes an essentially glandular organ. My investigations do not entirely bear out these statements, as observations on fifty prostates between the ages of birth and twenty years seem to indicate a rather gradual increase in the number and size of branches of the tubules up to the period of puberty, at which time there is a tremendous increase in the glandular elements, as is shown in comparing Figs 1 and 2.

During the second decade there is a very great increase in size. Ten specimens over fifteen years and under twenty years average 3.0 cm in length, which is more than twice that of the average prostate during the first decade. The average width is 3.8 cm and the thickness 2.1 cm.

TABLE SHOWING CHANGES IN SIZE OF THE PROSTATE GLAND AT VARIOUS AGES

Age	Number of cases	Length		Width		Height	
		Variation	Average	Variation	Average	Variation	Average
First decade (1-10 years)	38	cm 1.0-1.7	cm 1.2	cm 1.0-2.0	cm 1.5	cm 0.7-1.3	cm 0.9
Second decade (10-20 years)	10	2.5-3.5	3.0		3.8	1.8-2.4	2.1
Third decade (20-30 years)	40	2.8-4.0	3.3	3.6-5.2	4.1	2.0-3.0	2.4
Fourth decade (30-40 years)	33	2.4-4.0	3.15	3.0-5.0	4.1	1.6-3.0	2.55
Fifth decade (40-50 years)	42	3.0-4.6	3.45	3.6-5.0	4.0	2.3-3.8	2.65
Sixth decade (50-60 years)	29	2.4-4.5	3.65	3.3-5.0	4.37	2.4-3.4	2.75
Old age (60 years+)	32	2.6-4.5	3.23	3.0-5.0	4.12	2.0-3.6	2.47

The proper way to consider the size of the prostate seems to be to group the various specimens into decades and the figures obtained have been arranged in a table. Inspection of this table shows that the prostate gland reaches adult size during the third decade. Changes occurring after that period are comparatively slight. The average length is 3.3 cm, width 4.1 cm, and height 2.4 cm.

The figures quoted by all authors seem to vary slightly. Wilson and McGrath consider the average adult prostate to be 3.4 cm in length, 4.4 cm in width, and 1.5 cm in thickness, weight 16 or 17 grammes. Cuthbert Wallace places its dimensions at 3.0 cm for length,

width 3.6 cm, thickness 1.8 cm, average weight 20.5 grammes. Sir Henry Thompson states the average measurements in fifty normal adult prostates to be as follows: Length 1.4 inches, width 1.75 inches, thickness 0.7 inch, weight 4 drachms and 38 grains. These figures correspond fairly well with those of Deschamps,<sup>5</sup> Senn,<sup>31</sup> Gross,<sup>12</sup> and Hodgson,<sup>14</sup> but are somewhat smaller than those of Dupuytren.<sup>7</sup>

During the fifth and sixth decades in life there seems to be a slight increase in all of the dimensions of the prostate, but considering all specimens this only amounts to a few millimetres. During the period of old age there is a drop back in size so that these specimens resemble those of the third decade more closely than any of the others. It is noticed in examining the glands of this period that they are either a little smaller in size and atrophied in appearance than those of the preceding period or a little larger and inclined to have the appearance of an hypertrophied condition. The specimens of this period have more abnormalities than those of any of the others, 56.1 per cent of all specimens observed showing some deviation from the normal. Thirty-three per cent of the prostates over sixty years of age show more or less a condition of adenomatous hypertrophy.

In cross-sections through its middle portion the prostate gland seems to be made up of concentric layers of tissue. The innermost or central area consists of the horseshoe-shaped urethra with the verumontanum which is made up of the ejaculatory ducts and utricle with their muscular and connective-tissue walls, the terminal ends of the prostatic tubules with their rather thinly disposed circular layers of muscle. The stroma of this layer is not very abundant and is made up of connective tissue for the most part with a moderate amount of smooth muscle-fibres but practically no elastic tissue-fibres. The next layer in the lateral and posterior directions is made up for the most part of stroma with practically no tubular tissue except the ducts proper, which have very few branches. The stroma is largely made up of connective tissue with a generous sprinkling of smooth muscle-cells which are not arranged in definite bundles except around the tubular ducts, where there are two layers, the inner circle which is quite thin and the outer longitudinal which is comparatively thick. There are a moderate number of elastic tissue-fibres here also. In the anterior region there are observed the tubules of the anterior lobe with a very slight amount of muscle around them quite firmly imbedded in the stroma, which consists in the anterior region of the middle concentric layer of a considerable number of smooth muscle-fibres interspersed with the white fibrous tissue bundles with occasional fibres of elastic tissue. Near the upper

border of the layer are seen a few bundles of striated muscle-fibres which in my specimens have not been found to exist among the tubular branches. Wallace, however, reports that he has observed them around some of the peripheral branches of lateral lobe tubules. The outermost of these concentric layers is exceedingly interesting, as it contains practically all of the branches of the posterior and lateral lobe tubules. The middle and anterior lobes are contained for the most part in the middle concentric layer. In the outer layer there is a great preponderance of muscular tissue and mucosa over all other elements of the gland. In the posterior and lateral portions the muscular tissue is practically all smooth and surrounds the tubular elements as has been described. In the anterior portion and extending down the lateral borders almost to the posterior surface are found the striated fibres which make up the so-called muscle of Henle. This muscular tissue is so arranged that near the most anterior portion of the gland it is almost the only tissue present. Looking from this point towards the urethra it is seen to become less and less, gradually shading off and being scattered among the smooth muscle and connective-tissue fibres so that at the edge of the middle concentric layer there are only occasional fibres noted. There is less and less striated muscle down the lateral borders of the gland until it finally disappears altogether.

There are islands of lymphoid tissue scattered here and there in the adult prostates. Rarely one finds some of these areas in the prepuberty specimens. They seem to be most frequently met with in specimens older than thirty years. Waldeyer has found similar areas in the prostate of a dog and Weski has studied them in the human and believes them to be normal anatomical structures.

The base of the prostate is intimately attached to the musculature of the bladder.

In regard to the internal sphincter of the human bladder Versari concludes from his investigations (1) The smooth muscle sphincter of the urinary bladder of man constitutes a structure by itself, which develops independently of the middle layer of the bladder, the circular muscle layer of the urethra and the musculature of the ureters. (2) The sphincter is made up of an urethral and a trigonal portion, and it is the urethral portion only which assumes the form of a ring surrounding the initial part of the urethra. The first groups of the fibres of the sphincter arranged in bundles correspond to the anterior arch of the urethral portion, from there immediately follow those of the urethral portion of the posterior arch, and these last are apparently



those of the trigonal portion. The posterior arch of muscle extends, little by little with new bundles, either upward to occupy part of the trigonal area, or downward along the posterior wall of the urethra, so that it comes to have an extent much greater than the anterior. On the other hand, the older view held by Krause, Hyrtl, Gegenbauer and others is that the sphincter is a continuation downward of the circular musculature of the bladder. The study of sections including the vesical sphincter in this series bears out the conclusions of Versari in regard to its structure.

The capsule of the prostate is composed of a structure which is made up of closely knit connective-tissue fibres and surrounds the entire organ except at the base between the entrance of the ejaculatory ducts into the substance of the prostate and the junction of the bladder wall with the gland. Here the tubules of the middle lobe are almost free and have as a consequence very thick muscular and connective-tissue walls. The large blood-vessels which supply the prostate run in the capsule and intralobular partitions for the most part and are most numerous on the anterior portion of the capsule.

The glandular elements of the prostate are in every instance divided into five portions corresponding to the five original groups of tubular evaginations noted in the embryo. The division between the middle and two lateral lobes becomes less and less noticeable as age advances, but the orifices of the middle lobe tubules are always widely separated from all other tubular orifices and quite closely grouped together. The middle lobe tubules always grow backward posteriorly to the broad ribbon-like sphincter of the vesical orifice and its tubules are never found imbedding themselves in it or extending within the sphincter. This is an important fact to be noted when considering pathological conditions at the vesical orifice.

The lateral lobes during the period of middle age become more and more prominent and cause a bulging of the lateral surfaces to a marked degree, thus making the transverse diameter of the organ proportionately greater than the prepuberty specimens studied. The number of branches of these and tubules of other lobes of the prostate are markedly increased but the number of tubules is certainly not increased and seems rather to be decreased, but this is a variable matter which is undoubtedly determined in the embryo and the exact number is a personal characteristic.

The posterior lobe is fairly well separated from other portions of the gland and is divided off by a rather firm and, in some instances, quite thick connective-tissue partition. It is always present as is the lobe itself and is intimately attached to the ejaculatory ducts which are not imbedded in this partition but seem to be set upon its anterior surface. This is a decidedly important matter to the surgeon in enucleating a prostate either by Squier's suprapubic intra-urethral method, in which the enucleating finger approaches the partition and attached ejaculatory ducts and passes along to the upper

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end of the verumontanum, which is usually removed without injuring the ducts and which surely would not be injured if the verumontanum, which is usually torn through with some difficulty, were cut with the scissors, or Young's perineal method, in which the two parallel longitudinal incisions must be extended through the partition, thus preserving the ejaculatory ducts, in order that the enucleating instrument may go into the lateral lobe cavities, because otherwise it will lead into the capsule of the gland and proper enucleation is then an impossibility. The posterior lobe is the part of the gland felt per rectum. Its tubules are in most respects similar to those of the other lobes. In some cases, however, they seem not to be quite so large and in most instances there is evidence that they do not secrete prostatic fluid actively. The branches of these tubules are usually not as numerous as those of the other lobes and have a thinner layer of muscle surrounding them.

The anterior lobe varies greatly in different specimens. At the time of birth it consists of two small unimportant tubules with very few branches. In the postpuberty specimen the anterior lobe is quite prominent and is made up of tubules which branch extensively and are apparently actively secreting prostatic fluid. A number of important changes are noted when the prepuberty prostates are compared with the gland in adult life. The mucosa of the terminal branches of prostatic tubules in prepuberty specimens is made up of cuboidal-shaped cells with nuclei which are quite large and situated in the centre of the cells. They are usually two layers thick and occasionally three. Scattered here and there are occasional cylindrical-shaped cells with the nuclei elongated and in the centre of the cell. The lumina are very small and apparently devoid of secretion. The mucous cells are placed upon a felt-like base made up of minute connective-tissue fibres, as described by Walker. The smooth muscle layer surrounding the terminal branches are very interesting as brought out by Van Gieson's differential stain. Each branch is surrounded by a definite layer of smooth muscle circularly arranged. The branches occur in groups of 5 to 10 and the entire tubule is surrounded by a much heavier envelope of smooth muscle also circularly arranged. Outside of this envelope there are several small bundles of longitudinal fibres which occur at intervals around the tubule but not as a definite intact sheet. The branches of tubules all extend backward towards the base of the prostate with the exception of a few of the most anterior tubules of the lateral and posterior lobes. The collecting ducts are situated at the most anterior portion of a given group of branches and pass directly towards the verumontanum so that almost the entire duct, with the exception of a very small portion which turns forward, may be seen in one cross-section. The ducts are lined by mucous membrane which resembles that already described in practically every detail. There is, however, a great difference noted in the arrangement of the musculature. A thick layer of smooth muscle surrounds the ducts but it is arranged almost entirely in a longitudinal direction, very little circular muscle being noted. There are practically no branches from this part of the tubule, most of them occurring in the peripheral third of the gland. In the verumontanum the tubule turns and runs forward for a slight distance again and about nine-tenths of them open on the lateral walls of the verumontanum in such a manner that there is a little leaflet of tissue covering the orifice which is an exceedingly

important factor in protecting the tubules of the gland from an inpouring of urine and other foreign matter when the posterior urethra is put under pressure. The direction of the openings of the tubules of the prostate and ejaculatory ducts is an important consideration also because instrumentation will frequently cause an infection by forcing foreign substances into them. In the adult prostate there is noted a great change in the mucosa. I have found in my specimens that the tubules and their branches are lined by a single layer of high cylindrical cells with the nuclei at their bases. Occasionally there is inserted between the bases of adjoining cells a round or conical cell, as Krause pointed out. In some cases there is a piling up of the cylindrical cells, but I have not found that there is a double layer of cylindrical cells in all of the terminal branches as Langerhans states. Near the orifices of the ducts the epithelium is transitional in type, being similar to that of the urethra itself. The muscle bundles surrounding the tubular branches are very thick in the peripheral portions of the gland and particularly in the case of middle lobe tubules near its base. These muscular bundles are much more pronounced comparatively speaking in the case of the younger specimens than in the older and this is probably due largely to the fact that the entire gland becomes more compactly arranged after puberty.

Some of the older writers gave very interesting reports upon the minute anatomy of the prostate. Dr Hansfield Jones<sup>18</sup> in 1847 affirmed that pale or unstriped muscle entered largely into the composition of the gland. Kolliker<sup>21</sup> in 1848 declared that the larger part of the organ was constituted of pale muscular tissue and that the smaller portion only consisted of glandular tissue. Professor Ellis<sup>8</sup> of University College in 1856 declared the prostate to be essentially a muscular body "as only so small a portion of the prostate is glandular, the propriety of calling that body a gland is rendered doubtful, for the small secreting glands contained in it are but appendages of the mucous membrane which project amongst the muscular fibres in the same way as the other glands of the urethra extend into the surrounding sub-mucous tissues." Jarjavay partly confirmed the above view also.

Sir Henry Thompson wrote as follows in 1873 "The glands themselves are somewhat peculiar and characteristic of the prostate. They are classified as multilobular or compound racemose. The walls of the vesicles and crypts are covered with an extremely regular epithelium, the cells of which show a disposition to be ovoid but apparently become polygonal under the influence of lateral pressure. The ducts are lined with prismatic cells."

Rudinger states that no other viscus encloses within itself so great a number of muscular fibres in such a limited area as the prostate, especially where the glandular substance is subordinate to the muscular layers.

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A specimen obtained from a man seventy-six years old (Fig 3) who died of cerebral lues bears out in a general way the findings observed in the younger specimens described. There is, however, a difference noted which is interesting. The tubules are for the most part collapsed and show definite signs of atrophy. Here and there are seen corpora amylacea of various sizes.

*The Middle Lobe*—Ten moderately large, numerous branching tubules form the middle lobe which is in this instance usual in size. The course of the tubules is similar to that of like structures already mentioned and the ducts open on the summit of the verumontanum and its lateral surfaces above the point where the ejaculatory ducts empty into the urethra. There are a number of corpora amylacea present and only a few of the tubules are distended, most of them showing signs of atrophy. They extend behind the vesical sphincter to a level with its upper border. In most places it is easy to distinguish the point of separation between the middle and lateral lobes, although there is not a well-defined wall of tissue separating them at all points.

*Lateral Lobes*—The largest portion of the gland is occupied by twenty-four tubules which are contained within the two lateral lobes. Corpora amylacea are present and a few of the lumina are distended, but for the most part are collapsed and show definite signs of atrophy. The lumina are almost entirely obliterated in some instances, being occupied by a shrunken and distorted mucosa, while the muscle-bundles are not nearly so thick and distinct as those observed in younger specimens. The course of the tubules follows very closely those previously described. They open a little below the mouths of the ejaculatory ducts in the prostatic furrows or on the lower lateral surfaces of the verumontanum. A few of them open into the prostatic furrows above and below this point and a few open upon the lateral walls of the urethra itself.

*The Posterior Lobe*—This is definitely separated from all other portions of the gland by a thick, well-defined layer of muscle and connective tissue. The separation is more complete in this instance than it is in any other gland studied. The tubules, eleven in number, have grown back to a point behind the ejaculatory ducts and reach the same level as do those of the lateral and middle lobes. The branches are numerous but not large and invariably show a distinct atrophy. There are a few corpora amylacea in these tubules and where they occur the lumina are entirely occupied by the laminated bodies, the walls of the tubules being contracted upon them and much constricted before and behind. The ducts of the posterior lobe tubules proceed behind the ejaculatory ducts and empty into the urethra upon its floor outward from the verumontanum as far as the apex of the gland. The outermost tubules have branches which extend forward.

*The anterior lobe* is comparatively large in this specimen. It is made up of five tubules which are quite as large as those of the other lobes. These tubules have many branches, some of which are distended but most of which show signs of atrophy as do those of the other lobes. The ducts of this lobe empty into the urethra upon its ventral and lateral walls. They are not grouped near the mouths of the ejaculatory ducts as are those of the middle and lateral lobes but enter indiscriminately. Histologically these tubules present an appearance similar to that of the tubules of other lobes.

The mucous membrane of the tubules of this specimen is quite interesting. In the prepuberty specimens it is composed of epithelial cells piled two or three

deep, with nuclei which are elongated and almost fill the cell. The lumina of the tubules of that period are very small and show no evidence of containing secretion. In early adult life and middle age the mucosa in most cases is composed of a single layer of high columnar epithelium with a granular protoplasm and a fairly small round nucleus situated near the base. There are occasional conical cells placed here and there between the bases of the others and the entire epithelium placed upon a felt work of fibrils of connective tissue. The lumina are large and filled with secretion. Rarely there is seen a corpus amylacea. There are folds in the epithelial lining of normal middle-age specimens but very few finger-like projections or bridging of epithelium, such as is noted in adenomatous hypertrophy. In this specimen the mucosa is composed of columnar epithelium cells of the usual type but the individual cells are not so clear cut. Their nuclei are somewhat smaller and stain more deeply. Very few of the lumina are distended. Most of them are collapsed and show little or no evidence of secretion. The mucous layer is in many instances shrunk and distorted. Corpora amylacea are fairly numerous. They usually occupy the entire lumen of the tubule, the walls being contracted tightly down upon them. The smooth muscular envelopes retain their characteristic arrangement but are atrophied in appearance. There is a moderate amount of lymphoid tissue here and there throughout the stroma. By utilizing Van Gieson's differential stain it has been determined that in the middle lobe 25 per cent of the stroma is composed of smooth muscle. In the lateral lobes 25 per cent is smooth muscle and 10 per cent striated muscle. The posterior lobe, like the middle lobe, contains no striated muscle and the stroma contains about 25 per cent smooth muscle. The anterior lobe stroma is made up of 30 per cent striated muscle, 25 per cent smooth muscle and the remainder connective and elastic tissue fibres.

In youth before puberty the comparison between glandular tissue and stroma is about one to five. After puberty in the adult it is one to three, and in normal old age one to four.

*The subtrigonal glands* are present but are small in size. They are similar in type to those already described as regards their histology and location. In this specimen twenty-one of them are found between the middle of the trigonum vesicæ and the vesical orifice. In no instance do any of them have branches and they do not extend through the submucosa.

*The tubules of Albarran*, thirty-three in number, are found in their usual location. They seem rather more extensive in this specimen. The uppermost branches have grown to a point on a level with the upper margin of the vesical sphincter. They are contained within the sphincter and for the most part are embedded in the submucosa, although a few branches have extended for a short distance into the muscularis. Most of these structures empty into the urethra near the upper end of the verumontanum but there are a few that have their openings between this point and the vesical orifice on the floor of the urethra. The tubules have quite a number of branches and their histological characteristics are similar to those already described in other specimens. An interesting feature of this particular group is that quite a number of the tubules are distended, in some cases reaching five or six times the usual size.

*The verumontanum* is usual in shape and its length is 1.85 cm, being 0.5 cm high and 0.43 cm broad at its base. About 15 per cent of the stroma of

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the verumontanum is smooth muscle, the remainder being entirely composed of connective tissue, as there is no elastic tissue present in this structure

*The utriculus prostaticus* is present and fairly large in size. It is found only in the verumontanum and ends in a bicornuate manner. It opens in the midline on the crest of the verumontanum below the mouths of the ejaculatory ducts and is surrounded by a number of large tubules, some of which empty into the utricle and a few of which empty into the urethra itself. The muscular walls surrounding the utricle are quite thick and prominent. The ejaculatory ducts accompany the utricle and the three structures are firmly held together by a thick muscular envelope which also surrounds the tubules mentioned above. The mucosa of the utricle is thrown into numerous folds and the lumen of the structure is almost filled with them.

*The vasa deferentia* are thick walled and retain their customary shape and appearance. Occasional simple tubular glands without branches are seen in their walls and communicate with the lumina. The ampullæ of the vasa deferentia are large in size and have a folded mucous membrane which almost occludes the lumina.

*The seminal vesicles* are collapsed and the mucosa folded. They are made up of a main chamber on each side with five small branches which are much folded and contained within a fibrous sheath. Their walls are thick and compact. They are surrounded by a rather rich blood supply which traverses the fibrous tissue between the convolutions of the various portions of this structure.

*The ejaculatory ducts* formed by the junction of the mouth of the seminal vesicle on each side and the vasa deferentia begin well within the substance of the prostate and proceed in an oblique direction until they reach the level of the upper end of the verumontanum, at which point they turn abruptly and pass almost perpendicularly up into the verumontanum, where they become separated by the utriculus prostaticus which is contained in the same thick sheath with them. They run parallel with the axis of the urethra for a considerable distance and then each one turns sharply laterally and empties into the urethra on the sides of the verumontanum in such a manner that a thin area of tissue extends over the mouths of the ducts.

*The Apex Group*—There are twelve small tubules with a few minute branches which make up the apex group of glands. These are delicate in their outlines, small in size and do not have thick muscular walls. They are found for a short distance in the membranous urethra as well as surrounding the urethra at the apex of the prostate. They do not extend deeply into the peri-urethral tissues. They are similar in type to those observed in other specimens.

The number of prostatic tubules is a subject that has been much discussed and concerning which there is a great deal of divergence of opinion. Svetlin by counting the excretory ducts has determined the number to vary between fifteen and thirty-two. I am convinced that in health most of the prostatic duct orifices are invisible to the eye or the cysto-urethroscope of Buerger or McCarthy. I have used the latter instrument repeatedly on a large number of cases and rarely have

been able to count more than fifteen duct orifices and these have usually been in pathological conditions in which they were held open due to induration of the tissues composing them. As has already been explained earlier in this paper, the prostatic tubules open into the urethra at an angle and in such a manner that the orifices are protected by a thin valve-like lappet of tissue which usually drops down over the orifices and closes them quite effectively, particularly upon distention of the posterior urethra. Kolliker has estimated the tubules to be thirty to fifty in number, Hessling fifteen to thirty. From the investigations made here it seems to be a much more accurate method to study the entire prostate gland, and in following the various tubules from section to section the exact number of tubular ducts opening into the urethra can be determined for each lobe of the prostate. By pursuing this method in twelve cases, varying in age from two and one-half months intra-uterine to seventy-six years of age, it has been found that the number of tubules of the prostate varies from forty-one to seventy-four, the average for all specimens observed being fifty-eight.

TABLE SHOWING NUMBER OF PROSTATIC AND OTHER TUBULES WHICH ENTER THE URETHRA

No	Age of specimen	Middle lobe	Lateral lobes		Posterior lobe	Anterior lobe	Total prostatic tubules	Subcervical glands Albarin	Subtrigonal glands	Apex group
			Right	Left						
1	2½ months, intra-uterine	0	0	0	0	0	0	0	0	0
2	3¼ months, intra-uterine	12	20	19	11	12	74	0	0	0
3		7	13	14	6	13	53	0	0	0
4	4 months, intra-uterine	10	23	23	4	14	74	8	0	0
5	4½ months, intra-uterine	0	21	21	10	7	59	11	5	0
6	7½ months, intra-uterine	11	18	18	9	8	64	9	4	12
7	At birth	9	17	17	11	2	56	19	9	19
8	4 years	12	10	14	11	5	52	33	23	26
9	4 years, Dr Vance's specimen	7	11	12	8	4	42	39	?	?
10	17 years	12	11	11	12	5	41	43	32	16
11	35 years	7	15	11	11	4	48	31	38	9
12	76 years	10	12	12	11	5	50	33	21	12
	Average	10	16	16	9	7	58	25	19	15

The five original independent lobes of the prostate have been distinguishable in every specimen observed in this research. The middle lobe has been definitely absent in one intra-uterine specimen, in five cases there has been some doubt about its presence and in 447 cases it has been definitely present, as shown in the accompanying table. Thus it is seen that this investigation bears out the statements of Griffith who

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declared that (1) the middle lobe may be either present or absent at the time of puberty and in adult life before enlargement takes place, (2) that this lobe is independent, having glands of its own which open upon parts of the posterior wall of the prostatic urethra Tandler and Zuckerkandl<sup>32</sup> agree with this opinion and base their theory of prostatic hypertrophy largely upon this anatomical fact Pallin,<sup>26</sup> Evatt,<sup>9</sup> Jores,<sup>10</sup> and others consider the middle lobe to be a glandular outgrowth from each lateral lobe

TABLE SHOWING THE FREQUENCY OF THE OCCURRENCE OF MIDDLE LOBES

Specimens	Number of definite middle lobes	Questionable middle lobes	Middle lobes definitely absent
Twenty cadavers in Dr Mall's laboratory	20	0	0
Ten fetuses	9	0	1
Thirty-three enlarged prostates in museum of Brady Institute of Urology	31	2	0
Forty autopsy specimens of enlarged prostates in Guy's Hospital, London	37	3	0
Three hundred fifty post-mortem specimens, Bellevue and Post-Graduate Hospitals, New York	350	0	0
Total	447	5	1

The number of tubules composing the middle lobe varies from 0 to 12, the average being 10 The average number of tubules in each lateral lobe is 16, as few as 10 being found and as many as 21 in one case The posterior lobe tubules vary from 4 to 12, the average being 9 The anterior lobe was found to be least conspicuous in the prostate of a new-born child which was exhaustively studied and remodelled in wax Another specimen showed as many as 14 After birth this particular group of prostatic tubules never numbered more than 5, although in a specimen observed just after puberty its tubules seem to be as actively functioning as any other portion of the structure The average number for all specimens is seven

The structures, which have been termed in this investigation "accessory organs," are interesting, and a discussion of histological characteristics seems proper

The trigonum vesicæ was shown by Lieutaud to be superimposed upon the vesical floor, its constituent fibres coming from each ureteral wall J Griffiths<sup>11</sup> believed it to be composed only of the innermost bands of muscular bundles of the bladder wall W Waldeyer<sup>37</sup> believes that there is a separate development of its musculature which is continuous with that of the ureters and the prostatic urethra There



is an absence of submucosa over the trigone. It has firm, smooth, thick-layered muscular membrane. Versari<sup>35</sup> concludes from his studies that normally the musculature of the trigonum vesicæ is made up of (a) the trigonal portion of the internal sphincter, (b) part of the muscular layers of the ureters, and (c) the muscle-bundles of their sheaths. In adults there are present in the trigonal region bundles which come from the muscular layer of the bladder. Walker<sup>36</sup> agrees with the above in part. He observes that from the ureter on each side a thick band of muscle passes down towards the urethra. These bands converge and unite so that this longitudinal muscle flows over the margin of the urethral opening in a continuous sheet. In the centre of the triangle formed by these bands of muscle the fibres appear to interlace indiscriminately. Delbet<sup>4</sup> declares the trigonum vesicæ to be an appendage of the ureteral walls. Congenital lack of an ureter shows the trigonum to be lacking on that side. Passavant has described a case in which the trigone was entirely separate from the bladder wall.

The mucosa of the trigonum is quite thick, being composed of many layers of transitional epithelial cells. This portion of the bladder mucosa is always smooth and free from folds, regardless of how trabeculated the remainder of the organ may be. The submucosa is not extensive. The group of mucous glands which I have called the subtrigonal group and which has been fully described is found extending from about the middle to the apex of the structure. There is a surprising increase in the number of tubules composing this group after birth. In an adult specimen as many as thirty-eight are observed, while before birth five is the greatest number. The average for all specimens is nineteen.

The muscle and connective-tissue bundles of the trigone are derived from the walls of the ureters and extend from the apex to the upper end of the verumontanum. The tissue composing the trigonum is very compactly arranged and this structure is very richly supplied with blood-vessels. The number of small vessels is so great that the trigonum has a dark-reddish appearance when seen post mortem or with the cystoscope.

The fibres from its apex connect with the upper end of the verumontanum and are seen to be arranged in a varying number of folds, usually two or three. This structure is normally an equilateral triangle, although the base or distance between the ureteral orifices is often a little less than the distance between ureter and the vesical orifice. In the first decade the average trigonum measures 1.2 cm. This increases in the second decade to 1.6 cm. During the third period it reaches

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adult size, 2.2 cm., and remains practically the same throughout adult life.

The superposition of the trigonum upon the bladder wall, as described by Lieutaud, can be demonstrated by Mall's method, in which the structure is dissected entirely free from the vesical wall.

Asymmetry of the trigone occurs with considerable frequency. In my series it occurs most frequently in the fourth decade. Fifty-nine of the entire number of specimens, or 26.3 per cent., show a considerable difference in the distance of the two ureters from the vesical orifice. This variation may be as much as 1.2 cm. and in this day of instrumental investigation of the bladder and ureters this is an important consideration. In adults the ureters may be as near to the vesical orifice as 1.5 cm. or as far from it as 5.0 cm. Eight and one-half per cent. of my specimens have a trigonum vesicæ more than 1.0 cm. larger than normal, while 2.7 per cent. are unusually small without other signs of abnormality. Seventeen specimens, or 7.6 per cent., show an hypertrophy of the trigonum vesicæ which stands out markedly superimposed upon the bladder. It is in every such case somewhat contracted with a deep bas-fond behind its base. This condition rarely, if ever, occurs before the fortieth year.

Abnormalities in the structure of the trigonum vesicæ are very frequently met with. The existence of an hypertrophy of the group of fibres extending from one ureter to the other is so common an occurrence that a so-called interureteric bar is taken for granted in adults. I have come across a number of specimens in which there is apparently no tissue extending from one ureter to the other, but there is a distinct bundle extending from each ureter to the vesical orifice. Frequently bundles of fibres extend toward the middle line and then curve rather sharply toward the apex, forming a wide V-shaped structure. Several of the specimens show the remarkable condition of a bar extending from one ureter just to the midline where it stops off short, and extending from the other ureter to the orifice of the bladder there is a well-marked bundle of fibres.

The structure of the internal sphincter has already been discussed. The tubules which occur within the sphincter chiefly on the floor of the vesical orifice are of great interest. They were described in detail by Albarran<sup>1</sup> and enlargements of this group attracted the attention of authors as early as 1700. Sir Everard Home in 1802 described pathological hypertrophies of this group as the "third lobe," and such conditions even to-day are mistaken by some writers for middle lobe enlargements. As a matter of fact, true enlargements of the middle

lobe are extremely rare, while hypertrophy of Albarran's group occurs to a greater or less extent in 25 per cent of the cases over thirty years of age, as shown by the examination of 350 postmortem specimens and about 500 cases observed by means of the cystoscope

These tubules make their appearance at about the fourth month of intra-uterine life. They are not very numerous up to the time of birth, as there are never more than eleven. After birth they increase greatly, so that in one specimen there are as many as forty-three. The average number for all specimens is twenty-five. Structurally they differ from prostatic tubules in a number of important details. There is not a differentiated layer of muscular and connective-tissue fibres around them, although in disease the fibrous tissue develops an encircling sheath in many instances. The mucosa is composed of two or three layers of low columnar or cuboidal epithelial cells, chiefly the latter placed upon a felt-like basement membrane. The lumina are small and usually circular or oval in shape and rarely have an irregular outline with finger-like projections, as do the prostatic tubules. These tubules in an adult resemble the tubules of an embryonic prostate gland to a considerable degree.

According to McMurrich<sup>24</sup> the seminal vesicles begin to develop at about the third intra-uterine month. The embryonic specimens observed bear out this statement. Gustaf Pallin<sup>26</sup> has described very accurately the development of the seminal vesicles. They grow backward and laterally, consisting of a main part which is convoluted and from which rather numerous short convoluted branches grow out. The seminal vesicles and lower ends of the vasa deferentia are bound together by a structure composed of anterior, middle, and posterior lamella. This fascia is of interest because it tends to prevent the dissemination of carcinoma of the seminal vesicles to contiguous structures, it causes a true middle lobe hypertrophy of the prostate to project into the bladder, and it supports the base of that viscus. The seminal vesicles attain adult size during the third decade, and normally do not enlarge after that period. Histologically the seminal vesicles show a thickened wall in later years of life composed of some muscular but mainly connective-tissue fibres. These are very compactly arranged. Their lumina are quite irregularly convoluted and lined with simple non-ciliated columnar epithelium containing yellow pigment. Enlargement of these structures occurs in 32.4 per cent of all cases over twenty years of age. The greatest period of affection is during the third decade, at which time 42.5 per cent are abnormal. The right seminal vesicle is enlarged three times as frequently as the left in this series,

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there being thirty-seven cases of the former and ten of the latter, and ten in which both sides are symmetrically enlarged. There are five cases of atrophy of both structures.

The vasa deferentia are comparatively larger in embryonic life than in specimens after birth. They widen out into the ampullæ in the region of the seminal vesicles and at that point there are observed a number of definite evaginations from the lumina into the solid walls which are lined with mucous membrane similar to that of the vasa deferentia themselves. These evaginations are only found after the period of adolescence. The mucosa of the vasa deferentia is made up in part of simple ciliated columnar epithelium and in part of stratified ciliated columnar cells with two rows of nuclei. The cilia are frequently absent. In the ampulla of the vas the epithelium is for the most part simple columnar in type and the cells often contain granules of yellow pigment.

The course of the ejaculatory ducts has already been described. They are lined as a rule by a single layer of columnar cells, although the mucosa is often folded and the cells are frequently arranged in two or three layers. Their walls are composed of smooth muscle and connective tissue circularly arranged, as Porosz described, but the walls become exceedingly frail in the region of the verumontanum so that any sphincteric action must be very slight. The main barrier against ascending infection seems to be the thin lappet of mucosa which is left above each orifice of the ducts as they enter the urethra obliquely on the lateral walls of the verumontanum. When these valve-like orifices become diseased, as in chronic posterior urethritis, they become indurated and are often held open, thus greatly increasing the danger of ascending infection and resulting epididymitis.

The utriculus prostaticus in old-age specimens is longer than in those of preceding periods, its average length being 0.89 cm. In later embryonic specimens as well as in the adult there are two types found. The most common is that which is contained within the tip or upper end of the verumontanum. The other extends to the base of the prostate. In this series there is one embryonic specimen which has a very small atrophied tube extending between the vasa deferentia and connecting with a thick-walled utricle which is found at the base of the prostate. This vestigial organ is absent in one case, the region usually occupied by it being filled by two tubules with many branches which enter the urethra separately. Its orifice is unprotected and, occurring as it does on the summit of the verumontanum in the midline and with its many tubules and branches contained within its wall, seems

to offer a splendid site for a stubborn infection, a fact which is borne out by clinical experience. We have in no instance found an ejaculatory duct opening into the utricle and Dr George S Huntington<sup>10</sup> asserts that he has never found the condition existing in the lower animals. Its mucosa is composed of stratified transitional epithelium and is usually much folded. The glands contained within its walls which are composed of compactly arranged smooth muscle and connective-tissue fibres are also lined with stratified epithelium.

The verumontanum is composed of tissue derived from the ejaculatory ducts and utricle which in their development push the floor of the urethra up into a mound. The length of that portion of the urethra between the vesical orifice and the upper end of the verumontanum increases quite markedly in the old-age period. During the second decade this distance measures 1.2 cm. It remains practically the same during the third and fourth decades, in the fifth decade it increases to 1.55 cm. Between fifty and sixty years of age this portion of the urethra increases to 1.75 cm and in the old-age period measures 1.85 cm. Histologically the verumontanum is very interesting, as most of the structures entering the prostatic portion of the urethra pass through its substance, including a large majority of the prostatic ducts. By the use of Van Gieson's stain it is noted that the main portion of the stroma is made up of connective-tissue fibres, although there is some smooth muscle besides that which surrounds the ducts of prostatic tubules, the ejaculatory ducts and utriculus prostaticus.

The upper end of the verumontanum is usually quite high and arises abruptly from the floor of the urethra, while the lower end tapers down and some tissue spreads out in one or two bands on each side while fibres become lost in the tissues of the urethral wall. In one interesting case<sup>23</sup> these laterally disposed bands became hypertrophied and completely blocked the urethra except at one small area forming a diaphragm-like obstruction.

A group of tubules occurs in the wall of the urethra in the region of the apex of the prostate which has been termed the apex group. They are found in every specimen older than seven and one-half months intra-uterine. The largest number, twenty-six, is noted in a specimen aged four years. In older specimens they are not so numerous. The average is fifteen for all specimens studied.

Histologically they consist of small tubules, sometimes simple, but in most of the older specimens they have two or three branches. They are very delicate in architecture, not being surrounded by a definite muscle or connective-tissue envelope. They extend for some distance into

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the walls of the urethra. Their lumina are small but fairly regular in outline. The mucosa is not folded. It is composed of one layer of small columnar epithelial cells. They are most numerous at the apex of the prostate and just below that point, but disappear from the urethral mucosa lower down in the membranous urethra.

*Nerves*—The prostate is richly supplied with nerves and contains ganglionic nodes, ganglion cells, and numerous end organs. They are derived from the inferior hypogastric plexus of the sympathetic system. A delicate plexus of nerve-fibres communicates between the seminal vesicles and prostate. Fibres from the anterior roots of the third and fourth sacral nerves are present. It is a well-known fact clinically that pathological conditions of the prostate are accompanied by very severe disturbances of various sorts. The most common of these are the referred pains which may occur in the small of the back, in or about the rectum, or down the legs. Timofeew in his very complete study has described a complicated system of nerve-fibres and endings which assists greatly in understanding this feature of the anatomy of the prostate. Von Planer described numerous nerve-endings situated in the superficial layer of the mucous membrane of the prostatic urethra. Timofeew describes a wide-meshed plexus of medullated fibres within the deeper layers of the capsule. Fine non-medullated fibrillæ pass through the prostate from the plexus and, branching freely, end between the epithelial cells. Other branches form tuft-like end bodies and still others encapsulated end organs. Some of these resemble Pacinian corpuscles with two fibres each, one of which is thick and enters as a naked axis cylinder and ends in the opposite pole as a pointed or knoblike structure, the other is thin, loses its medullary sheath, forms a finely divided fibrillary web and surrounds the axis cylinder of the first fibre as a loose tunic, but does not come in contact with it. He describes another nerve-ending as a single fibre more or less branching in all stages of transition from the simplest cylindrical form up to multiple branching forms besides the usual Pacinian corpuscles. Besides the sensory fibres he mentions the existence of many others which are apparently secretory, as they resemble similar fibres in other glandular structures. Timofeew describes both motor and sensory end structures on the fibres of Henle's muscle (striated). They are at first medullated and terminate as non-medullated fibres. The nerves of the smooth muscle-fibres are non-medullated. They form between the muscular layer thick plexuses of varicose fibrillæ which send out numerous branches.

The arteries of the prostate are derived from the internal pudic,

middle hemorrhoidal and chiefly from the inferior vesical. Branches of these vessels coursing in the capsule divide and enter the gland in the interlobular septa and dividing further send capillaries to nourish the individual branches.

The veins collect the blood from the capillaries just described and pass out to the lateral and anterior portions of the prostatic capsule, where they become quite large as a rule and intercommunicate very freely, forming the plexus of Santorini which receives the dorsal veins of the penis and is often the seat of phleboliths. This plexus also communicates with veins from the bladder, seminal vesicles, and rectum and is continued as the prostatovesical plexus to the internal iliac veins. There are exceedingly few veins found in the capsule of the posterior surface of the prostate, some of the veins collecting blood from the para-urethral region communicate with the vessels of the trigonum vesicæ.

The lymphatics begin as a network around the acini of the gland. They pass outward and form a second plexus beneath the capsule. Here collecting tubules arise, several of which pass from the posterior part of the gland. One trunk passes to the external iliac gland, one to the internal iliac gland, and several end in the lateral sacral glands and glands of the sacral promontory. An anterior trunk is joined by lymphatics from the membranous and prostatic urethra and passes to a gland on the internal pudic artery.

In conclusion I wish to express my thanks to Dr Hugh H. Young of the Brady Urological Institute, Johns Hopkins Hospital, Drs Charles Norris and Morgan Vance of the Pathological Department, Bellevue Hospital, and Dr J. Bentley Squier, Jr., of the Post-Graduate Hospital, for many favors granted in connection with this research.

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# GIANT-CELL TUMORS OF THE TENDON SHEATHS

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I WISH to report the following three cases of giant-cell tumors of the tendon sheaths, the first the writer was fortunate to see himself, the second was a patient of Dr Wm Stone, who has kindly given his permission to include it here, and the third was seen by Drs C E Farr and L A Wing in the Out-patient Department of the New York Hospital

CASE I—E H, a school girl of twelve years of age, applied at the Out-patient Department of the New York Hospital for a swelling at the base of the little finger of the left hand. She had noticed this for the last three or four months, in which time it had not grown larger as far as she knew. She did not remember ever having injured herself on this hand and could not account for the swelling.

The patient, who is a healthy, strong-looking girl of average build, has on the base of the flexor surface of the little finger on the left hand a hard, round, freely-movable mass about one centimetre in diameter, it is not attached to the overlying skin or to the tendons which seem to lie under it.

A vertical incision about one inch long was made over the mass and carried down through the subcutaneous tissue, whereupon the tumor literally "popped" out, not being attached, except for a thread-like pedicle at its base. It appeared to lie directly on the tendon without any attachment to it. There was very little bleeding and the tumor seemed rather avascular. On examination it resembled a piece of *maron glacé*, it was yellowish-brown in color with a smooth surface. On its inferior surface was a deep groove in which the tendon had lain. On section it cut with cartilaginous hardness, the cut surface being smooth and uniform in appearance.

The pathological report made by Dr W J Elser, pathologist to the New York Hospital, was as follows:

The specimen consists of a small tumor, the size of a bean, removed from the flexor surface of the little finger. Tumor is sharply circumscribed and was said to be freely movable.



FIG 1 —Giant-cell tumor of tendon sheath (Case I) at the base of the flexor surface of the little finger

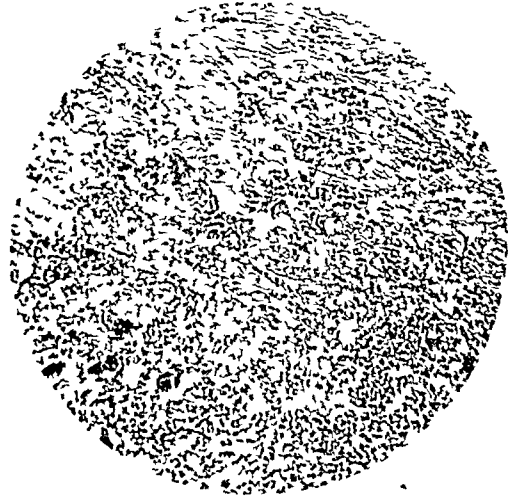


FIG 2 —Microscopic photograph of the tumor of Case I showing the numerous giant cells with large number of nuclei

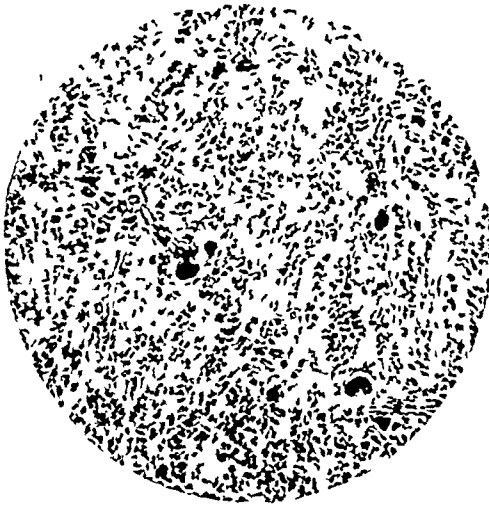


FIG 3 —Microscopic photograph of the tumor of Case II, showing cellular structure

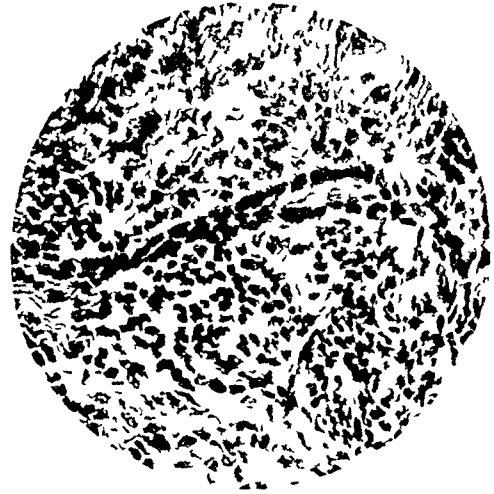


FIG 4 —Microscopic photograph of the tumor of Case III showing a blood-vessel with apparent proliferation of its endothelial cells



## GIANT-CELL TUMORS OF THE TENDON SHEATHS

*Microscopical examination* presents a picture closely resembling that of a so-called epulis. These tumors pass under the name of myeloid endothelioma. This name, however, is based upon a theory which has not definitely been established.

CASE II—Mr. G., forty-six years old, had pulmonary tuberculosis when thirty-two years of age, from which he apparently recovered. Since this time he has been engaged in active work in the city, he has suffered a good deal from indigestion and has had several attacks of "bronchitis." He first noticed the present trouble three years ago when he sprained his ankle playing golf. Since that time the swelling, a "small lump," has slowly increased in size and has only caused discomfort when irritated by his shoes. A second swelling close to the first appeared suddenly a few months before he consulted Dr. Stone.

On examination, a bilobed, tense, cystic-like mass was found at the base of the first and second metatarsal bones on the dorsum of the foot, there were no signs of inflammation and the mass did not appear to be attached to its surrounding structures.

Under a general anæsthetic the mass was easily excised and proved to be a bilobular tumor which was situated between the superficial and deep tendons of the first toe, the lobulations being caused by one tendon passing over and the other under the mass.

The patient recovered without any difficulty but died two years later from a recurrence of his tuberculosis, up to the time of his death there had been no recurrence of the growth.

Dr. James Ewing, of Cornell University Medical College, reported the tumor to be one of the so-called giant-celled sarcomas.

CASE III—The patient applied at the Out-patient Department of the New York Hospital, complaining of a swelling on the finger. M. C., female, thirty-eight years of age and of French birth, had for 18 months noticed a small swelling on the dorsal surface of the distal phalanx of the left index finger. She did not remember ever injuring this finger. The swelling had grown slowly until now it was about the size of a pea. On examination a small swelling was found on the dorsum of the distal phalanx of the left index finger, it was fixed to the deeper structures, the skin, however, being freely movable over it, it was slightly sensitive on pressure. Through a small incision the tumor was easily enucleated.

The pathological report by Dr. W. J. Elser was as follows:

Specimen consists of a small piece of tissue removed from dorsum of the distal phalanx of the left forefinger. This is the size of a bean. Firm in texture with appearance of fibrous tissue.

*Microscopical examination* shows a cellular growth, cells resembling

in some respects those found in endothelioma, in places there is a fusion of cells leading to the formation of somewhat indefinite giant-cells. Further sections made from this tumor show genuine giant-cells.

Though giant-cell tumors of the tendon sheaths are not particularly rare, little has appeared in English literature on this subject and nothing more than mention of them can be found in any of the American text-books. The French on the contrary have written many papers on this subject and the Germans are not far behind them. The literature extends back some sixty-two years when Chassaignac wrote his paper entitled "*Tumeur des gaines tendineuses*," which was soon followed by articles by Czerny, Billroth and others who classified them among the giant-celled sarcomas. In 1891, Haurtaux named them myelomas because of the similarity of their histology to the myeloid tumors of bone, since then many other names have been affixed, among which may be mentioned "*myeloid endothelioma*" (Bellamy), "*hamosiderinführendes Sarcoma gigantocellulare Xanthomatodes der Sehnen-scheider und Aponurosen*" (Spiess), and "*granulomata*" (Fleissig).

From the fact that little or nothing is said about giant-cell tumors of tendon sheaths in text-books on pathology and surgery, and comparatively little can be found in medical literature, it may be supposed that these tumors are rather rare. On the contrary, they appear to be fairly common, among 71 sarcomas of tendon sheaths reported by Rosenthal 45 were of the giant-cell variety, and Tourneux collected 54 of the latter type in the examination of 93 sarcomas. In this country Bloodgood appears to have seen a number of cases.

These tumors make their appearance most frequently during the second, third and fourth decades of life, though reports of cases as early as the ninth (Menciere) and as late as the eighty-second year (Reverdine) have been made. However, in the vast majority of instances they appear in the period between the twentieth and fortieth years. They are found more often in men than in woman, Spiess reporting them 24 times in the former and but 19 times in the latter. As to occupation 50 per cent are found in those engaged in manual labor.

The site of the lesion may be either the hands or the feet, but is found most often in the former, the commonest location being in the fingers, though at times it may be found in the palms of the hand. The right hand is affected twice as often as the left and the flexor surface is almost always the seat of the trouble, this surface seems to be the location in about 80 per cent of the cases (Spiess). In the

foot the most common site is over the peroneal tendons near the external malleolus

Traumatism is said to bear an intimate relationship to the development of these growths, this, however, is a disputed point. A history of sudden trauma may be obtained or there may be an indefinite history of a slight, oft-repeated irritation. This, by some, is thought to be deceptive, for, as in growths in other parts of the body, a history of trauma may be obtained in almost every case and is misleading, as any previous knock or scratch is remembered by an individual and ascribed by him as the cause of any growth which may appear later. Tourneux remarks on the apparent frequency of preceding trauma, but does not believe that we have enough direct evidence to ascribe it as a definite cause of the condition. It may be said here, that in the three cases reported in this communication no history of trauma could be obtained. Additional evidence in favor of it as an etiological factor may be found in the frequent appearance of the neoplasms in men, especially those engaged in manual labor, its choice of the flexor surface of the fingers and hand and its frequent appearance in the right hand.

The onset of these neoplasms is insidious, their growth is slow, because of the lack of subjective symptoms, the "lump" is often overlooked until it has attained a considerable size. Their duration may be from a few months to ten or twelve years, the average being three or four years. The swelling is never very large, varying from a few millimetres to several centimetres in diameter. They are painless, except when irritated, and do not interfere with the functions of the affected parts.

On examination they appear as hard, round, smooth, painless swellings which at times may be lobulated. The skin is freely movable over them and though they may be firmly fixed by the tendon sheath or fascia they do not often interfere with the movements of the tendons. At operation they are easily shelled out, without producing damage to the surrounding structures.

The shape and size of these tumors depend to a great extent upon the resistance of the surrounding structures, the strong fascia of the hand and foot bind them firmly down, limiting their size, and deep sulci are often produced by the tendons upon which they have been held, giving them at times a lobulated appearance.

The tumor when removed is found to be well encapsulated and usually some direct connection with the tendon sheath can be demonstrated. In size they vary from a few millimetres to several centimetres, never attaining a very large size because of the denseness of

the surrounding tissues Their surface is smooth and their color varies from a dark reddish-brown to a light yellow, in consistency they are hard and often cut with almost cartilaginous resistance, the cut surface is smooth and glistening and gives one the idea of cartilage

The histological picture is quite characteristic, it consists of a connective-tissue stroma containing numerous multinuclear giant-cells The stroma is usually composed of a matured type of fibrous connective tissue, though at times it may be cellular, if of the latter variety the cells may be round, spindle or of the mixed cell types, however, of whatever variety they may be the picture is that of a slowly growing tissue The cells are small, regular in outline and stain evenly, their nuclei stain uniformly with basic dyes, are regular in shape and outline and do not show any increase over the normal in mitotic figures The giant-cells may vary considerably in number, usually they are numerous, they are round, their cytoplasm stains uniformly and the nuclei are grouped centrally, giving the appearance of a whorl, quite different from the peripherally distributed nuclei of foreign body giant-cell as typified by those of the tubercle Their nuclei resemble those described for the stroma cells, they may vary from several to a hundred or more to a cell Adam considers these giant-cells to be of a matured type, identical with the myeloplaxes found in the bone-marrow The tissue is fairly vascular, at times red blood-cells or blood pigment may be found infiltrating between the fibres of the stroma

Certain lipochrome substances resembling the fatty body present in xanthoma cells are at times found and may be the cause of the yellow color of the tumor

Concerning this pigment, little definite information is known Under normal conditions lipochrome pigment, in considerable abundance, is found in the corpora lutea in the form of lutein and the yellow color of normal fat is said to be more or less due to this substance

In addition to this it is also found in ganglion cells during advancing life, and some authors believe that muscle undergoing brown atrophy contains this substance The fatty bodies found in the cells of xanthomas are apparently true lipochromes and some authors state that the greenish pigment found in chloromas is of the same substance The lipochromes in the cells of giant-cell tumors resemble those of xanthoma cells, however, we do not know the origin of this substance in these tumors It seems quite probable that it may be of the nature of a degenerative process, to substantiate this view we may again mention the fact of the presence of this material in certain of the nerve cells of individuals of advancing age and the degenerative changes in

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muscles, which are said to contain lipochromes. Adam, speaking of xanthomas, says, "Some observers attribute the growth to a preceding inflammation, while others (Ziegler) regard it as a lipomatous lymphangioma or endothelioma." Pollitzer asserts that xanthomas of the eyelid are not neoplasms but are due to the degeneration of pre-existing embryonal, misplaced muscle tissue. It appears to us that these facts would tend to strengthen the view of the degenerative origin of this yellow pigment.

The histological picture which has been described resembles more that of the giant-cell epulis than any other giant-cell tumor that we know of, however, it does not, like the epulis, develop from the periosteum as in no case has a definite connection with that layer been demonstrated. Certain other characteristics of behavior, in common with the epulis, are present, if entirely removed it does not recur and it does not metastasize. It is true that in a few cases reports of metastases have been made but we feel that these cases had either undergone sarcomatous changes or that the tumor in the first place was of a malignant variety of mixed-cell sarcoma. The general opinion seems to be that these tumors do not recur after removal and that they do not metastasize.

The question now arises as to the nature of these growths and by what name they should be called. To answer this question we would have to take up the discussion of giant-cell tumors in general. We, however, do not feel that the scope of this paper calls for such a course and therefore shall only attempt to state some of the principal views on the subject.

Among the modern writers who still adhere to the name of giant-cell sarcoma or myeloid sarcoma for this type of growth may be mentioned Tourneux, Spiess and Stewart.

Tourneux, in an article on sarcomas of the tendon sheaths, states that the giant-cell tumors may recur after removal and therefore cannot be considered as benign growths. Spiess in his study of 48 cases of giant-cell tumors of tendon sheaths comes to the conclusion that there are several varieties of these growths, that they are benign and should not recur after removal. Stewart, in a recent article in the *Lancet*, entitled Observations on Myeloid Sarcomas, divides giant-cell tumors into two classes, myeloid sarcomas and malignant giant-cell sarcomas, he believes that the former are only locally malignant, that their histological picture is that of a benign tumor and that if properly removed recurrence will not take place. This is in contrast to the malignant giant-cell sarcoma, the histological picture of which shows



active signs of proliferation. We believe that the term "sarcoma" should be reserved for new growths of mesenchymal origin which by their life history and histological picture satisfy the postulate of a malignant tumor. The neoplasm under consideration in this article certainly does not do this, it is slow in growth, does not recur after proper removal, does not produce metastases, and the microscopical picture is not one of active proliferation. To use the term "sarcoma" for such a tumor loses the significance for the name and also brings to one's mind the demand for radical treatment which in this case is entirely uncalled for.

Of the writers who use the name myeloma, believing that these growths are developed from cells which have to do with osteogenesis, may be mentioned Bellamy, Adam and Matthews. These authors consider the giant-cells to be similar to the myeloplaxes of bone. Bellamy claims to have seen proliferation of the endothelial cells of the smaller blood-vessels in tumors of the tendon sheaths and believes that the giant-cells may be formed in this way, he has therefore called the tumor a myeloendothelioma. We cannot find that his views as to endothelial proliferation have been confirmed by others, but in our third case, the microscopic sections showed vessels, in which the endothelial cells were markedly increased. The nuclei of these cells were very similar to those of the stroma cells. Because of this finding we cannot deny the endothelial origin of these tumors, nor do we feel, that in this one case, we have enough evidence to affirm it. If giant-cell tumors of tendon sheaths have their origin from myeloplaxes we would expect them at some time to be in direct communication with bone, there is, however, no proof that this occurs, the only suggestion being the fact that the commonest location of the growth is in the tendon sheaths which are in close proximity with bony surface, as found in the hands and feet.

Fleissig, because of the lack of polymorphism, polychromasia, destructive invasion of the surrounding tissue and mitosis, believes that these growths can no longer be classed among the neoplasma but must be placed with the granulomata. In this country Mallory has contended that the giant-cells in this type of growth are nothing more than foreign-body cells and that the tumor containing them should not be named from the presence of these cells but from the character of those of the stroma. This author goes so far as to call the osteoclasts of normal bone foreign-body giant-cells and that their presence signifies the erosion of bone. We cannot see that these writers have proved the inflammatory origin of these growths nor do we believe that the

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giant-cells of these tumors resemble in any way those due to chronic irritation

The microscopic structure of these tumors is, to be sure, that of cellular connective-tissue neoplasms, resembling sarcoma, but the behavior, as we have seen, is that of a simple benign growth. As we have before said, to call it a sarcoma is very misleading and makes one think of radical treatment which, as we have shown, is entirely uncalled for. To use the name endothelioma is unsatisfactory, in view of the fact that the nature of the cells comprising the growth has not been established. The term "myeloid" suggests some connection with the medullary cavity of bone, which has not been proven. Until further is known of the origin of these growths, we would suggest, for the lack of a better name, that they be called "giant-cell sarcoid tumors of the tendon sheaths." We agree with Bloodgood that the term "giant-cell" is well established and should not be dropped. And in view of the fact that the histological picture resembles that of a sarcoma, it has been suggested that we use the term "sarcoid" (from *σαρξ*, flesh, and *εἶδος*, form)

The treatment of these tumors should be of conservative character. They being well encapsulated, enucleation is easily performed through a small incision without disturbing neighboring structures.

In conclusion I wish to thank Drs. Stone, Fair and Wing for allowing me to use their cases, and Dr. James Ewing and Dr. W. J. Elser for their help to me while writing this paper.

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# FASCIA TRANSPLANTATION IN THE TREATMENT OF OLD FRACTURES OF THE PATELLA

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(From the Department of Surgery, Rush Medical College)

IN cases of fracture of the patella with wide separation of the fragments, which have been allowed to heal in this position, an elliptical defect in the extension apparatus of the knee, running transversely across, is the condition which remains. The fracture surfaces of the fragments are rounded or pointed by new bone formation from the ends. The joint cavity extends forward, between and in front of the fragments, is limited by the subcutaneous tissue and lined by a newly formed synovial membrane. The transverse bands about the upper fragment contract and bind it firmly against the shaft of the femur. This distorts and may completely obliterate the upper recessus of the joint. The quadriceps extensor gradually contracts and atrophies. Villous arthritis or chronic hydrops of the joint may develop.

In such cases the patients get around with great difficulty, walking carefully and with a limp. The knee frequently gives way, causing the patient to stumble or fall. Stairs have to be ascended or descended one step at a time. When lying the heel cannot be lifted from the bed and extension is possible only to a very limited degree.

The method of repair of the extension apparatus must vary according to the amount of separation and contracture. The upper fragment should be loosened and whenever possible the two fragments as well as the torn capsule should be brought into apposition, where, after freshening the edges, they are sutured. When after lateral incision and traction, apposition has still been impossible, various plastic procedures have been resorted to for closing the remaining defect.

The upper fragment has been displaced downward in one of two ways. Macewen made a large V-shaped incision in the quadriceps, pulled the fragment downward and closed the cut in the shape of a Y. The method has been successfully used in a number of cases, but Quenu and Wrede object to it because of the weakening and adhesions of the quadriceps which interfere with flexion. Lister operated in two stages, suturing the fragments as close together as possible. At the first operation and completing the approximation after a number of weeks

## FASCIA TRANSPLANTATION

this plan should be avoided if it is found possible to make any kind of a satisfactory repair in one stage

The lower fragment was shifted upward by von Bergmann to meet the upper one. The tibial spine with its tibial patellar tendon was detached and displaced upward where it was attached to the upper end of the tibia. The method has been abandoned because the distance gained is frequently insufficient to close the defect and it is difficult to attach the tuberosity in its new position.

Plastic flaps have been turned into the defect from the surrounding tissues. The soft parts were first used in this way by Ferraresi who turned down a flap consisting of fascia and a layer of the underlying quadriceps femoris muscle. The patellar fragments may even be excised in such cases with satisfactory results. Shanz shifted the detached lower end of the sartorius muscle into the defect, suturing it to the quadriceps above and tibial patellar tendon below. Julius Wolf and Rosenberger employed bony and fibrous flaps, reflected from the anterior portions of the patella fragments, but they affect only a feeble and imperfect closure of the defect.

In the case herewith reported after the greatest possible apposition of the fragments had been accomplished there still remained a defect of one inch. This defect was then bridged over by a free transplantation of the fascia lata. The details of the case are as follows:

Mr. R. L., age thirty, entered the Presbyterian Hospital, December 6, 1914, with the following history: March 19, 1914, he jumped from a wagon, lighting upon both feet. He experienced severe pain in the left knee which gave way and threw him to the ground. When assisted to his feet he was unable to walk or to extend the limb. A physician diagnosed fracture of the patella and applied a posterior splint which was worn for eight weeks. At the end of that time he was unable to walk without a crutch because of flexion of the knee when the body weight was thrown upon it. A short posterior splint was worn for two months, since which time he has gotten around with a cane. Improvement has been slight. The knee frequently flexes unexpectedly, causing him to fall. Stairs are ascended and descended with great difficulty and lifting is impossible so that he has been unable to resume work as an expressman.

Examination shows a muscular young man who walks with a marked limp in the left leg. There is moderate swelling of the left knee which extends a short distance above the normal level of the joint. The quadriceps muscle is somewhat atrophied. He is unable to extend the leg or to lift the heel from the bed when the

thigh is flexed. Palpation shows the patella separated into an upper and a lower fragment and three fingers can be inserted into the intervening space with the limb in extension (Fig 1)

*Operation* (December 7, 1914) —Ether anæsthesia. A longitudinal incision seven inches in length was made over the knee, exposing the lower part of the quadriceps muscle, the two patellar fragments and the tibiopatellar tendon. There was non-union between the widely separated upper and lower margins of the tear, leaving a transverse elliptical opening into the knee-joint. The joint cavity extended anteriorly between and in front of the patellar fragments into the subcutaneous tissue. It was lined by a newly-formed synovial membrane. The fracture surface of the upper fragment was rounded and that of the lower fragment pointed by new bone formation. The upper fragment was firmly fixed above the condyles of the femur by the contracted lateral ligaments. They were incised and extensive downward traction made on the fragment. It was impossible to bring the fragments closer than one inch of each other. They were held in this position by an encircling suture of heavy silk. The tears in the ligaments were sutured with catgut, but near the patella on either side they could not be closed (Fig 2). To bridge over the remaining defect without weakening the surrounding parts a free transplant was taken from the fascia lata of the middle of the thigh. It was sutured above to the quadriceps, below to the tibiopatellar tendon, and at the sides to the lateral ligaments of the joint (Fig 3). Aseptic wound healing occurred. A plaster cast was worn for four weeks, after which a posterior splint was applied and the patient allowed to walk. Since the eighth week he has been using the limb without any support. Extension was almost complete at that time, but flexion was limited to 45 degrees. Fig 4 shows the relation of the fragments, and Fig 5 the amount of extension at the end of six months. At present, eight months after the operation, the limb can be flexed beyond 90 degrees and is practically as strong as before the injury. He has been working for the past three months.

The advantage of a free fascial transplant where the fragments cannot be approximated is that it affords a stronger closure of the defect than can be obtained by taking flaps from the weaker surrounding fascia, and in no way weakens any of the normal portions of the extension apparatus. The transplant should be made wide enough to cover the defect in the lateral ligaments of the patella as well as that between the fragments.

Fig. 1.—Before operation



Fig. 2.—Fragments encircled by silk suture and capsule sutured laterally

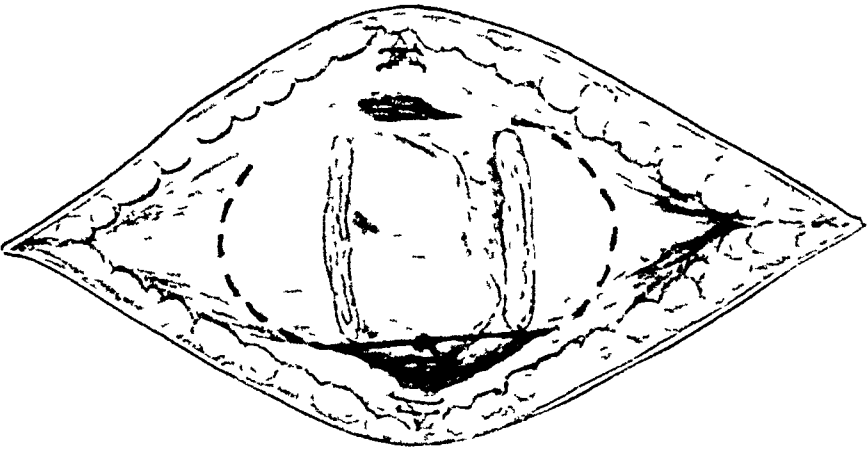


Fig. 3.—Tissue transplant sutured in place

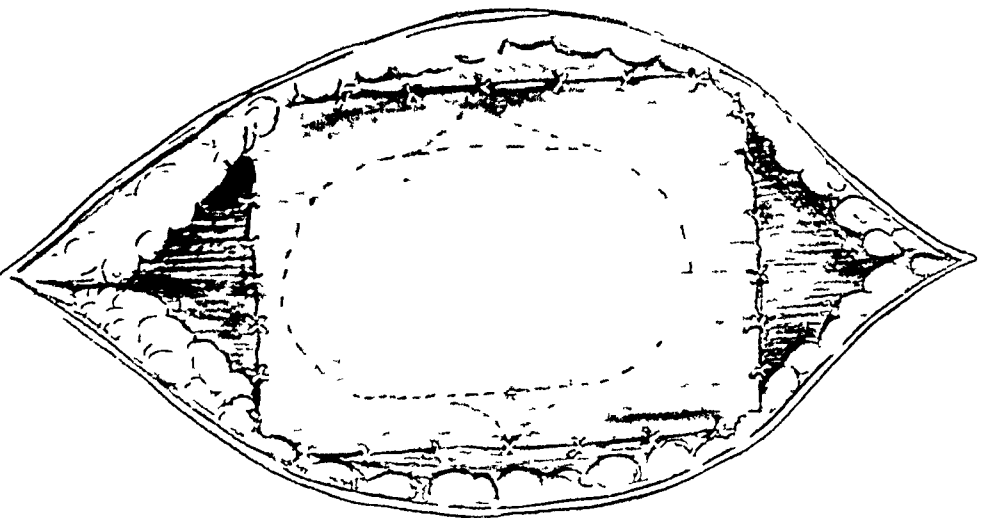




FIG 4 —Six months after operation



FIG 5 —Amount of extension six months after operation

# DECOMPRESSION UNDER LOCAL ANÆSTHESIA

BY HERBERT P. COLE, M.D.

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HAVING occasion recently to perform decompression upon an epileptic with a dubious prognosis from the stand-point of cure, local anæsthesia was adopted as the procedure subjecting the patient to the least risks

In so far as we are aware a complete decompression under local anæsthesia has not been reported before in this country, this together with the ease with which the technic was performed without untoward results prompts us to present our experience to the profession

The patient, referred by Dr. Seale Harris of Birmingham, Alabama, a white male, aged thirty-three, gave a history of injury to the skull years before admission to our clinic. The location of injury was indefinite, though the onset of the typical epileptic convulsions definitely followed the injury. There being no evidence of a focal nature, decompression was advised only because years of medical treatment had not availed.

The prognosis being explained to the patient as offering at best only a possibility of improvement and a meagre probability for cure was, nevertheless, eagerly accepted. Believing that a decompression performed upon the patient in a conscious state might disclose the focal point more readily, we determined upon the use of local anæsthesia as the method offering the least operative risk.

*Operation* (April 29, 1915) —Preliminary scopolamine and morphine. After the usual preparation a tourniquet was placed about the head with a comfortably firm pressure. After the method of Braun about 60 cc. of a one per cent. novocaine-adrenalin solution was injected at seven points over the temporal region above the tourniquet (see Fig. 1). The solution was injected in all the layers of the scalp down to the periosteum and the points of injection were connected both superficially and in the deep tissues, thus providing a seven-sided area of anæsthesia.

An osteoplastic flap decompression was then performed with no discomfort to the patient. We noted with considerable surprise the absolute absence of pain in the periosteum and upon trephining the bone and using the Gigli saw and rongeur. A rather large dural flap was made, without sensation to the patient,



the pia, beyond appearing rather œdematous, was apparently normal. Pressure stimuli upon the anterior Rolandic area elicited little response and we believe the infiltrating fluid on the scalp tended to reduce pressure stimuli—a possible objection to the use of local anæsthesia in some cases. Shortly after beginning our pressure stimuli the patient's pulse rapidly rose to 150 per minute, the arteries became engorged, and the patient passed through a typical epileptic seizure of several minutes' duration. There were no focal signs indicating that our stimuli produced the attack. He was controlled by force, and at the end of the seizure the operation was completed by passing the dural flap out beneath the bone into the temporal muscle. The osteoplastic flap was replaced and sutured. The patient returned to the ward with a pulse of 120, in excellent spirits, and complained of no pain.

*Post-operative* —The patient made an uninterrupted recovery from the operation, suffered very little post-operative pain and presented no urinary changes. He described his experience as not an unpleasant one and complained that the only discomfort was from the pressure of the tourniquet. He was conscious of most of the remarks addressed to him and recalled having a lapse and the sensation of having had an epileptic seizure.

This patient has had a diminution in the number and severity of his attacks.

**CONCLUSION** —Cerebral cases presenting grave or uncertain prognoses do not warrant serious operative risks. Local anæsthesia permits of extensive intracranial procedures. It will also doubtless do much to clear up the localization of the motor and sensory areas by permitting extensive observations upon the conscious patient.



FIG. 1—Dots mark points of deep anesthesia for the incision. Dotted line marks lines of superficial and deep to a minor degree of anesthesia. Solid line marks line of incision.



FIG. 2—Actual photograph of decompression under local anesthesia.



# THE ACTION OF RADIUM ON TRANSPLANTED TUMORS OF ANIMALS

BY FRANCIS CARTER WOOD, M.D.

AND

FREDERICK PRIME, JR., M.D.

OF NEW YORK

(From Columbia University, George Crocker Special Research Fund)

DURING the last few years there has been much discussion as to the therapeutic use of radium in the treatment of malignant growths, and opinions as to its value, based chiefly on clinical reports, have differed greatly. It has, therefore, seemed important that the question of the efficiency of radium as a destructive agent for tumor cells should be settled as soon as possible, the more especially, perhaps, as a great deal of newspaper notoriety has of late been given to this method of treatment of malignant growths in man.

Whether the beta or the gamma rays are the more efficient in treating tumors, or whether both should be employed, are questions which are still undecided. So much, however, is certain that unless the beta rays can largely be removed by filtration, radium cannot be used to treat neoplasms lying even a few centimetres beneath the skin, because the intervening normal structures will be destroyed by these rays before the growth itself is influenced.

No extensive quantitative studies of the lethal effect of radium on tumor cells have yet been made, though Wedd and Russ,<sup>1</sup> and Wedd and Chambers<sup>2</sup> have published the results of experiments on a few animals. Pentimalli<sup>3</sup> could find no morphological changes in mouse tumors exposed for a number of hours and then examined microscopically, it would have been extraordinary if he had. v. Wassermann<sup>4</sup> thought that two hours' exposure to 50 mgm of mesothorium screen with 15 mm of brass destroyed the gonocytes, so that the cells remained alive for a few days only to die later because of interference with mitotic division. As has been shown by Wood and Prime,<sup>5</sup> however, his experiments were too few, and the methods used too unsatisfactory, either to prove his theories or to give information as to the lethal dose of mesothorium, which is presumably the same as that

of an equivalent quantity of radium\* Thus in most reports of work done with human or animal tumors, the quantity of the radium element used, the screen employed, the distance of the tissue from the radium, and the time of exposure have not been accurately stated As these factors furnish the only scientific basis for computing the efficiency of radio-active substances, it was decided to carry out a line of experiments on the biological action of radium, using animal tumors as an index of the lethal effect A few of these experiments are here reported

The method was as follows Rat and mouse tumors of various types were used, among them the Ehrlich spindle-cell mouse sarcoma, the Flexner-Jobling rat carcinoma, and mouse carcinomata No 11 and No 180 of the Crocker Fund series These were treated either after removal from the host or *in situ* In the former method a portion of the tumor to be used was cut into small pieces of uniform size, and these were moistened with Ringer's solution, put into hollow slides, covered with a thin cover-glass, sealed with paraffin, and exposed to the tubes of radium The strictest asepsis was observed in all these operations Four tubes of radium, containing respectively 83, 20, 17, and 10 mgm of element were used, singly and in combinations giving 100 mgm and 30 mgm The dimensions of the tubes were as follows

Quantity	Length	Diameter
10 mgm	17 mm	3.5 mm
17 mgm	14.5 mm	2.7 mm
20 mgm	19.4 mm	3.4 mm
83 mgm	28.7 mm	3.4 mm

Brass was uniformly employed as a filter, in thin or thick sheets, as required to pass or eliminate the hard beta rays The tissue was placed directly beneath the cover-glass, and in most cases in contact with it, and in order to prevent all loss of vitality of the tumor cells during the more lengthy exposures, the exposed and the control tissues were kept in separate "Thermos" vessels at a temperature slightly above 0° C, comparative tests having shown that the action of the radium was not influenced by the temperature at which the growth was preserved After exposure to the beta and gamma rays in different amounts for varying lengths of time, portions of the treated tumor, as well as untreated fragments which had been kept for controls, were inoculated into animals of the same strain

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\* Mesothorium is always estimated in terms of an equivalent amount of radium, and is not sold by weight The commercial product contains about 25 per cent of radium

## ACTION OF RADIUM ON TRANSPLANTED TUMORS

The alpha rays were not employed in any of these experiments, as they have almost no penetrating power, cause superficial burns only, and cannot be used practically in the treatment of tumors except those of the skin. The tissue was exposed either to a mixture of beta and gamma rays or to the gamma rays alone.

The beta rays from radium are extremely complex, but, roughly, may be said to consist of soft, medium, and hard rays, as judged by their spectra and absorption coefficients in metal screens. The softer groups are absorbed by 0.4 mm of brass, whereas the medium and hard beta rays penetrate this and have a range in the tissues of about 8 mm. A brass screen of about 1.2 mm thickness will absorb all but a negligible fraction of the medium and hard groups.

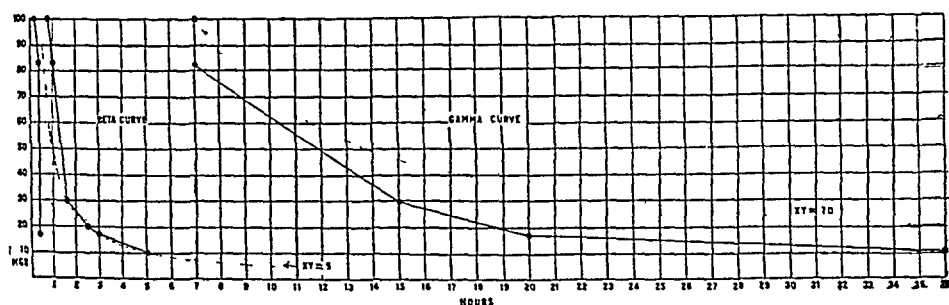


FIG. 1.—Plottings of curves of observed minimal lethal exposures on the abscissæ against milligrammes of radium on the ordinates. The first curve from the left shows the time required to kill carcinoma and sarcoma cells when the glass tubes containing the radium are unscreened. The observation includes 100 mgm, 83 mgm, and 17 mgm. The second solid curve gives the results when the glass tubes are screened with 0.4 mm of brass. The dotted curve is that of  $\gamma=5$ . The solid curve furthest to the right gives the results with gamma rays, obtained by screening the radium tubes with 1.2 mm of brass and 5 mm of filter paper. The dotted line is the curve of  $\gamma=70$ . From this chart the approximate time of exposure necessary to kill all tumor cells at a given distance can be estimated for each weight of radium, or, if preferred, the time of exposure can be found on the chart and then by following up one of the vertical lines the amount of radium required to kill the cells at the given distance can be determined.

The gamma rays are by far the most penetrating of the three varieties of rays, though 10 per cent are absorbed by 1 cm of tissue. They pass easily through 1.2 mm of brass, only about 3 per cent being absorbed. In passing through the metal screens used to remove the beta rays, the gamma rays generate soft secondary beta rays of very slight penetration, and in order to absorb these and thus use as pure gamma rays as possible, a mass of filter paper (Schleicher and Schull, No. 575) 5 mm thick, was placed beneath the brass. Such pure cellulose, in virtue of the low molecular weight of its constituent elements, does not appreciably absorb the gamma rays.

One large group of experiments was undertaken, in which the tumor tissue was exposed *in vitro* to radium, the radiations being filtered through 0.4 mm of brass, a cover-glass 0.15 mm thick, and the glass of the tube containing the radium, 0.5 mm in thickness, a total distance of about one and one-tenth millimetres. No paper filter was used in this

# WOOD AND PRIME

case The results, tabulated in Table I, show that 100 mgm of radium will kill tumor cells at this distance after forty-five minutes' application, 83 mgm after one hour, 30 mgm after one and one-half hours, 20 mgm after two and one-half hours, 17 mgm after three hours, and 10 mgm after five hours No difference in the lethal dose on any of the various tumors used was noted

TABLE I

Character of rays	Mgm of radium	Time of irradiation	Number of mice		Growth of tumor	
			Inoculated	Survived	+	-
Beta and gamma	83	30 minutes	72	61	26	35
		Controls	72	57	43	14
		45 minutes	72	61	1	60
		Controls	72	57	43	14
		1 hour	48	44	0	44
		Controls	48	36	32	4
		2 hours	144	130	0	130
		Controls	144	133	88	45
		3 hours	120	105	0	105
		Controls	120	91	87	4
		4 hours	72	65	0	65
		Controls	72	57	52	5
		1 hour	48	44	15	29
		Controls	48	33	20	13
Beta and gamma	17	2 hours	96	91	23	68
		Controls	96	84	55	29
		3 hours	144	116	0	116
		Controls	144	107	103	4
		4 hours	72	70	0	70
		Controls	72	57	52	5

The results, when plotted with weight of radium as ordinates and time as abscissæ (Fig 1), give a curve approximating very closely to a rectangular hyperbola, that is, to a curve representing a condition in which the product of two variables is equal to a constant For comparison, the curve of  $xy=5$  has been plotted as a broken line, and it will be noted that the fit of the two curves is very good for a biological experiment Since the distance between the radium and the tissue was the same in each series of experiments, the only two variables were the weight of radium element and the time of exposure

The tumor tissue which had been exposed to both beta and gamma rays for a time just too short to kill the cells, showed marked slowing in growth rate as compared to the unexposed controls, and, in several of the series, tumor cells which had been exposed did not even begin to grow until five or six weeks had elapsed, in the controls, on the contrary, nodules appeared in from seven to ten days after inoculation of the untreated tumor cells This shows the necessity for long periods

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of observation before a tumor can be considered to have been killed by radiation. Similar delayed growths have been noted in man.

If, however, the beta rays were filtered out, a great difference was noted in the time required to cause the death of tumor tissue. In order

## TABLE II

Character of rays	Mgm. of radium	Time of irradiation	Number of mice		Growth of tumor	
			Inoculated	Survived	+	-
Gamma	100	6 hours	120	107	13	94
		Controls	120	111	110	1
		7 hours	48	46	0	46
		Controls	48	42	38	4
		8 hours	48	45	0	45
		Controls	48	47	41	6
		12 hours	96	89	0	89
		Controls	96	85	80	5
		18 hours	120	94	0	94
		Controls	120	102	100	2
Gamma	83	6 hours	72	62	18	44
		Controls	72	56	55	1
		7 hours	48	45	0	45
		Controls	48	45	45	0
		8 hours	48	37	0	37
		Controls	48	38	31	7
		12 hours	144	106	0	106
		Controls	144	112	104	8
		18 hours	144	118	0	118
		Controls	144	121	98	23
Gamma	30	6 hours	24	23	21	2
		Controls	24	21	21	0
		11 hours	96	65	3	62
		Controls	96	70	67	3
		12 hours	144	114	7	107
		Controls	144	112	104	8
		15 hours	96	65	3	62
		Controls	96	70	67	3
		18 hours	168	145	0	145
		Controls	168	145	131	14
Gamma	17	6 hours	72	62	55	7
		Controls	72	56	55	1
		12 hours	144	119	41	78
		Controls	144	112	104	8
		15 hours	48	47	11	36
		Controls	48	44	32	12
		18 hours	144	117	19	98
		Controls	144	121	99	22
		20 hours	24	24	0	24
		Controls	24	23	22	1

to remove the secondary beta rays as far as possible, a screen of filter paper (S & S No 575) 5 mm thick was used in addition to 12 mm of brass, it being assumed on the authority of Keetman and Mayer<sup>6</sup> that by this filtration practically only the gamma rays would reach the exposed tissue. The distance, therefore, from the radium tube to the



tissue was about 6.9 mm. After a long series of experiments it was found that exposures of seven hours to 100 mgm or to 83 mgm of radium were necessary to kill the tumor cells. Thirty mgm killed at a point between fifteen and eighteen hours, while 17 mgm and 10 mgm killed the tumor cells in twenty and thirty-six hours respectively (Table II). In brief, a much longer time was required when the gamma rays only were used. When the radium was filtered through 1.2 mm of brass raised 5 mm above the cover-glass but without filter paper, the results were about the same as when the filter paper was used, showing that the secondary beta radiations generated by the impact of the gamma rays on brass are not practically effective. The only result attending failure to employ the filter paper would be a greater or less burning of the skin. It may be said, in passing, that it is impossible to destroy a metastatic nodule of breast carcinoma in man without burning the skin to a slight degree. In animals, however, the skin is less susceptible and will stand long exposures without serious injury.

The results have been plotted graphically, and the curve  $xy=70$ , also, has been drawn in a broken line. In this case, the fit is nearly, though not quite, as close to the theoretical as in the curve of the combined beta and gamma action, nevertheless, the chart furnishes a means of estimating the quantity of radium element and time of exposure necessary to kill a cancer cell at any chosen distance. It must always be remembered that the action varies inversely as the square of the distance, and, as the distances plotted are respectively 1.1 mm and 6.9 mm, the amount of time required for a given distance, say 13.8 mm, is computed as follows. The square of 6.9 is 47.6 and that of 13.8 is 190.4. These two values are in a ratio of 1:4, hence, if the distance is doubled, the exposure is quadrupled. That extremely long exposures or very large amounts of radium are required to kill cancer cells at a distance of, say, 10 cm, is evident from this.

The sharply rising curve, tending to become parallel with the vertical ordinate, shows also that when the distance between the cancer cell and the radium tube is small, but little is gained by greatly increasing the amount of radium employed. If 100 mgm kill in one hour, 200 or 300 mgm will take at least half an hour. It is better, therefore, if large quantities of radium are to be used, to distribute the substance about or in the tumor so that each tube acts separately, rather than to combine the whole amount in a single tube. This is the procedure which is now practised by those who use small glass or metal tubes containing radium emanations inserted into various portions of the tumor to be treated.

## ACTION OF RADIUM ON TRANSPLANTED TUMORS

For the lack of sharpness in the lethal dose of gamma rays (Table II) it is impossible to offer any adequate explanation. With the beta rays, the time and dose required to kill a tumor fragment is quite definitely fixed, as has been repeatedly demonstrated in this laboratory on a great variety of tumors, and there is no appreciable difference in the results of radiation of sarcoma and of carcinoma cells. In the case of the gamma rays, on the other hand, the exact determination of a minimal lethal dose for moderate quantities of the element, say 20 mgm, is difficult. To kill every one of a series of tumor fragments requires a much longer time than to kill 80 to 95 per cent of such fragments. As an example, when 30 mgm element were used for six hours, the radiated fragments and controls grew in about the same proportion, while after eleven hours only 22 per cent of the irradiated particles grew, though there were 72 per cent of positives in the controls. About the same proportion occurs until, as Table II shows, the death of all the tumor cells is accomplished after an exposure of eighteen hours. As just stated, this variability in the death of tumor cells is not at present explicable. It may be that the lethal action of the gamma rays is exhibited only in groups of young cells which are undergoing or have recently undergone mitosis, for example, and that only older cells escape to grow in the tissues of the host and produce a tumor, or, again, it may be that the rays act by the direct production of toxic catabolic products (for instance, cholin, as suggested by Werner), and that the individual tumor cells contain different amounts of the lecithin from which the cholin is produced, so that only highly charged cells are injured. A third explanation may be that the generation of sufficient secondary beta rays to kill the cells depends upon the blood content of the tissue, and, hence, its iron content, as the secondary rays from iron are more penetrating than those from substances of lower molecular weight. There is, in fact, much variability in the amount of blood in different fragments of tumor. In these cases, as in exposures to the beta rays, the growth of the tumor which had received a sublethal dose was always much less rapid than was that of the control, as has been shown by Russ and Chambers (*loc cit*), while practically no late growths followed treatment with the gamma rays, as was the case after beta ray exposures.

The periods as thus determined are somewhat longer than the time required to destroy the cells in a small skin metastasis from a carcinoma of the human female breast. One of us (Wood) has found that exposures of six to eight hours with 83 to 100 mgm of radium, screened

with 12 mm of brass and 5 mm of filter paper, will in many instances cause permanent disappearance of these nodules. A shorter application to such metastatic nodules slows the growth but does not kill the tumor cells, while still shorter exposures or smaller quantities used under the same conditions have a stimulating effect. These observations show that the statement, made by several German experimenters (v Wassermann, Pentimalli, etc.), that mouse carcinoma is much more resistant to radium than human neoplasms of the same type, is not wholly justifiable. Any one who has attempted to cure a primary, rapidly growing carcinoma must have been impressed with the wonderful resistance which such tissues often display toward the action of radium, though, as is well known, some other types of malignant neoplasms in man, such as the basal-cell epitheliomata, are much more easily affected.

When the excised tumor tissue was exposed *in vitro* directly to the action of the radium, with no filter except the cover-glass intervening, the cells were killed, as proved by inoculation, by 100 mgm and 83 mgm in ten minutes, and by 17 mgm in twenty minutes, thus experiment demonstrates the great destructive power of the softer groups of beta rays. The use of such unfiltered rays is possible in man only in treating superficial growths, where the severe burning which may result can be limited to the tumor area and, hence, be of no importance.

In the second part of the experiment, a carcinoma, No 11, was exposed *in vivo* to the action of radium, and was then removed, and the fragments were inoculated into other animals. In these cases the animal was anæsthetized and the skin over the tumor was reflected, and then, after a small portion of the mass had been removed and put away on ice for use as a control, the tube of radium was applied to the tumor, which was protected only by a 0.4 mm brass sheet. After the application of 83 mgm of radium for two hours, some of the tumor tissue was removed from an area directly beneath the radium tube, and this, upon inoculation, showed some slowing in growth as compared with the control, but the cells were not killed, as is the case even after one hour *in vitro*. The constant supply of fresh nutriment to the cells by the blood, and the removal of any chemical products formed by the radium in the tissue, must account for this difference. Tissue removed from the other side of the tumor, also *directly* under the radium tube, but about 11 cm distant from it, showed no slowing in growth nor delay in appearance, upon inoculation, but grew quite as well as, or even a little better than, the controls. Therefore, the gamma rays from

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even so large an amount of radium as 83 mgm of element have not sufficient power to affect tissue at a distance of 1 cm during two hours' exposure. As 1 cm of tissue absorbs nearly all the beta rays these would not be effective over the space mentioned. The experiment was not continued over longer periods as it is difficult to keep mice under ether anaesthesia for more than two hours.

In these, and in similar experiments not detailed here, the law of inverse squares is clearly shown. For example, if the distance of the tube from the proximal portion of the tumor is, as in the above experiment, 11 mm, and from the distal portion 11 mm, then the effect is not as 1 to 10 but as 1 to 100, when the conditions due to the influence of the long tube in which the radium is housed are taken into consideration, according to the formulæ to be given later, the ratio between the intensities at the two distances is found to be as 1 to 18. Since two hours were required to affect the superficial layers of the tumor, at least thirty-six hours would have been needed to influence the cells on the deeper aspect.

If the law of inverse squares holds accurately, which is the case only when the radium is considered as all gathered at one point, the squares of 11 and 69 being respectively 121 and 4761, the results should be approximately the larger figure divided by the smaller, or as 1:40. The exposure, therefore, at a distance of 69 mm should be at least forty times as long as at 11 mm. As a matter of fact, experiments with 100 mgm and with 83 mgm showed that the proportion was about 1:8 or 1:9. This difference is due, as will be shown later, to the fact that when the large tubes containing 100 mgm of radium were placed over the tissue at *A*, only that portion of the radium which was immediately above the tumor material was effective, whereas when the tube was raised to 69 mm above the tissue, as at *B*, the radium in the extremities of the tube exerted a greater proportional effect than was possible when the tube was only 11 mm distant (Fig 2). With the smaller tubes of radium the ratio was approximately the same, the proportion being as 1:7.

When the 17 mgm tube was used unscreened, the proportion as compared to the same quantity fully screened was as 1:110. But little reliance can be placed upon these figures, however, because of the difficulty of determining accurately the death point when using the unscreened tube, consequent upon rapid killing of the tissues, a few minutes more or less introducing a large error, and because of the impossibility of measuring exactly the lethal effect of the various groups

of beta rays which are effective when no screens are used and the distance from the tube is only a few millimetres. Some of the softer beta rays must be extremely destructive, but they are quickly absorbed by the first millimetre of tissue, or even of air.

When a tube is used as in our experiments, and the distance from the tube to the tumor material is small, the radium at the end of the tube is not as effective as that near the middle which is closer to the tissue particle, as has already been said. As a series of exposures, made at distances of 6.9 mm and 13.8 mm from a tube 2.8 cm long containing 83 mgm of radium element, showed that the time of exposure was

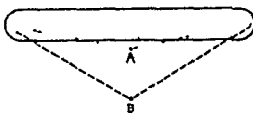


FIG 2

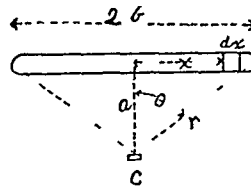


FIG 3

less than the theoretical, it was evident that when the tube was more distant from the tissue the radium in the ends became effective. The period required, as found experimentally, was between 2.5 and 3 times at double the distance, instead of the theoretical four times. By simple formulæ, for which the authors are indebted to Professor G. B. Pegram of the Department of Physics, Columbia University, a correction can be obtained as if the radium were all gathered at one point. For those who may be interested the formulæ are given here. The results show that the calculated and observed time for the two distances are very close.

Let length of cylinder of radium  $= 2b$ ,

distance from centre of radium  
tube (Fig 3) to tumor cell at C  $= a$

and total amount of radium  $= Q$

And let intensity of radiation at a  
point P due to an amount of ra-

dium  $dQ$  at a distance  $r$  from P  $= K \frac{dQ}{r^2}$

Neglect the effect of the diameter of the tube, likening it to a line distribution of the radium

Amount of radium per unit length of tube  $= \frac{Q}{2b}$

Amount of radium in length  $dx$  of tube  $= \frac{Q}{2b} dx$

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Then intensity of radiation at  $C$  is given by

$$\begin{aligned}
 I &= \int_{-b}^b K \frac{Q}{2b} \frac{dx}{r^2} = \int_{-b}^b K \frac{Q}{2b} \frac{dx}{a^2 + x^2} \\
 &= K Q \frac{1}{ab} \tan^{-1} \frac{b}{a} \quad (1) \\
 &= K Q \frac{1}{ab} \theta
 \end{aligned}$$

Hence — The intensity of the radiation at  $C$  is equal to the intensity of radiation at *unit* distance from an amount at radium  $= \frac{Q}{ab} \tan^{-1} \frac{b}{a} = \frac{Q}{ab} \theta$

( $\theta$  being expressed in radians)

Further — The intensities of radiation at two different distances,  $a_1$  and  $a_2$ , are in the ratio

$$\frac{I_2}{I_1} = \frac{\frac{1}{a_2} \tan^{-1} \frac{b}{a_2}}{\frac{1}{a_1} \tan^{-1} \frac{b}{a_1}} = \frac{a_1 \theta_2}{a_2 \theta_1} \quad (2)$$

Calculations by the above formulæ of the effectiveness of the 83 mgm tube of radium are as follows —

$$\begin{aligned}
 b &= 14 \text{ cm} \\
 a_1 &= 0.11 \text{ cm} \\
 a_2 &= 0.69 \text{ cm} \\
 \theta_1 &= \tan^{-1} \frac{b}{a_1} = \frac{14}{0.11} = 127
 \end{aligned}$$

From a table of natural tangents, this is found to be the tangent of  $85^\circ 30'$ , which from a table of angles as radians is found to be equal to 1.49

In the same way

$$\theta_2 = \frac{14}{0.69} = 2 = 63^\circ 26' = 1.11 \text{ radians}$$

Then from equation (1)

$$I_{0.11} = \frac{83}{14 \times 0.11} \times 1.49 = 803$$

That is, the intensity of radiation of a tube of radium containing 83 mgm of element at a distance of 0.11 cm is equivalent to that of 803 mgm at a distance of 1 cm

Similarly

$$I_{0.69} = \frac{83}{14 \times 0.69} \times 1.11 = 95.3$$

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That is, the intensity of radiation of a tube of radium containing 83 mgm of element at a distance of 0.69 cm is equivalent to that of 95.3 mgm at a distance of 1 cm

The relative intensities are given by equation (2)

$$\frac{I_{0.11}}{I_{0.69}} = \frac{a_{0.69} \theta_{0.11}}{a_{0.11} \theta_{0.69}} = 1 \text{ to } 8.3$$

As a matter of observation, the 83 mgm tube kills at 0.11 cm in one hour and at 0.69 cm in seven hours, a very satisfactory agreement for biological work.

The relative intensities when the distance from the 83 mgm tube was 0.69 cm and 1.38 cm respectively, are computed as follows —

$$\begin{aligned} b &= 1.4 \text{ cm} \\ a_1 &= 0.69 \text{ cm} \\ a_2 &= 1.38 \text{ cm} \end{aligned}$$

$$\theta_{0.69} = \frac{1.4}{0.69} = 63^\circ 26' = 1.11 \text{ radians}$$

$$\theta_{1.38} = \frac{1.4}{1.38} = 1.014 = 45^\circ 24' = 0.792 \text{ radians}$$

Hence — The relative intensities are

$$\frac{I_{0.69}}{I_{1.38}} = \frac{1.38 \times 1.11}{0.69 \times 0.792} = \frac{1.5318}{0.5464} = 1 \text{ to } 2.8$$

a very close agreement with the experimental results

Some of the tumors which showed growth after the application of either beta or gamma rays were inoculated, together with their controls, into a second and third generation, and in many cases the treated tumors showed a marked slowing in their growth rate as compared with the controls, in some instances, indeed, even up to the sixth generation this change was noticeable, and further investigation may show that a still longer period is required for the tumors to resume their normal rate of growth. The final results will be published in a later paper.

There is some question as to the reason for this slow growth. Probably it is due to injury of the mechanism for mitotic division of the cells, such as Hertwig<sup>7</sup> has demonstrated in the eggs of frogs. The late appearance of the inoculated tumor is not due, in all probability, to small dosage of cells in the implanted fragment, for, if this were the case, the slowing would not be noted in the second or third generation. Stimulation is apparent also in tumors treated with too small doses or for an insufficient time, as Lazarus-Barlow and Beckton<sup>8</sup> found to be the case with *Ascaris* ova, and as has been so frequently noted clinically. This stimulation is probably effected in two ways — first, by direct action

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on the cell mechanism, and, second, by the increased vascularity induced by the inflammatory reaction in and about the malignant growth

As discontinuous exposures are often necessary in the practical application of radium, experiments were made to see if the sum of a series of exposures was as effective as a single application for the same time. After the lethal dose of radium for continuous treatment had been found, the same amount of exposure was given under exactly the same conditions, but intermittently over twelve and thirty hours, and it was found that the minimal lethal dose was the same whether the treatment was continuous or interrupted. Such short interruptions, however, extending over only thirty hours, would not be of great value in human treatment, for the object of the intervening periods would be only to prevent burning, and this would not be avoided when the interruption covered so short a period as was necessary in our experiments in order to keep the tumor alive. It may be questioned whether intermittent exposures which permit a partial recovery of the cells are ultimately as effective. In treating small subcutaneous nodules in human breast carcinoma, one of us (Wood) has found, for example, that two exposures of four hours two weeks apart were not as efficient as a single one of eight hours. Probably the cells recover in the interval.

In all these experiments, it will be noted, the tissue exposed to the beta radiation must also be affected by the gamma rays, but in the time during which the action takes place such effect must be minimal, as is proved by the results of nearly pure gamma ray exposures. It is perfectly possible to deflect the beta rays with a powerful magnet and allow them to act on tissues without the complicating effect of the gamma rays, as Abbe<sup>9</sup> has suggested, but because, in this method, the beta rays are scattered in a fan-like spray, the total action is much diminished and the time required to produce a lethal effect with the radium available is so great that the tissues could not have been kept alive for a sufficient period even at 0° C. Hence, it was impossible to make the experiment.

The question whether the gamma radiation kills by its own direct action or by the formation in the tissues of secondary beta rays has often been discussed, but as it has no practical bearing its investigation was not attempted. That the action is probably due to secondary beta rays and not to primary gamma rays, is the opinion of Rutherford,<sup>10</sup> Keetman and Mayer (*loc cit*), Joly, and others, and is suggested, if not proved, by some recent experiments of Abbe (*loc cit*). The



ultimate factor may be the chemical action following the ionization produced in the tissues, though, as Wilson's experiments<sup>11</sup> have shown, the ionization is due, not to the direct action of the gamma rays, but to the action of the beta particles which are liberated from the atoms of matter traversed by the gamma rays

Neither has any attempt been made to verify experimentally the view, so widely held in Germany, that the entire action of the beta rays on the cells depends upon the capacity of these rays to cause ionization, and is consequent upon the destruction of the lecithin of the cells with the separation of cholin, the toxic effect being due to the cholin so set free<sup>12</sup> According to this view, the effect of radium or X-rays on the cell is entirely dependent upon its lecithin content, and the assumption is made that tumor cells contain more lecithin than normal tissue, an assumption which is quite unwarranted by chemical analyses so far published

#### CONCLUSIONS

1 Three factors only are important in the action of radium on tumors time of exposure, amount of radium element, and distance between the radium tube and the tumor tissue

2 The removal by suitable filters of the larger part of the beta rays diminishes proportionately the effect of the radium, but the effect of the gamma rays is in accordance with the same general law which governs the beta rays

3 Sublethal exposures slow the growth of tumor cells for some time, while still shorter treatments seem to stimulate the cellular activities

4 The facts derived from our experiments regarding the quantity of radium element and the time of exposure necessary for a given distance, may be applied, with reasonable accuracy, to human malignant tumors, the curves shown in Fig 1 being used as a basis for the estimation These experiments show also that when only pure gamma rays are used the necessary exposure is eight times as long as that required when the gamma and hard beta rays combined are employed, but as the latter are largely absorbed by 1 cm of tissue the gamma rays alone must be used for all deep work

5 The effect of radium radiations on tumor cells *in vitro* is less marked than is that on isolated cellular elements This explains the fact that an exposure which will destroy a small metastatic nodule in man is quite ineffective in the case of a well vascularized primary carcinoma

# ACTION OF RADIUM ON TRANSPLANTED TUMORS

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## BOOK REVIEWS

DISEASES OF THE NOSE, THROAT AND EAR, Medical and Surgical By WILLIAM LINCOLN BALLANGER, M D , Professor of Otolaryngology, and Laryngology, College of Physicians and Surgeons, Department of Medicine, University of Illinois, Chicago Fourth Edition, Revised and Enlarged Lea & Febiger Philadelphia and New York, 1914 Roy 8vo, 1080 pages

THIS work is encyclopædic in character and provided with a wealth of illustrations which cover every phase of the text The previous edition of the work has been favorably reviewed in the ANNALS OF SURGERY so that no elaborate review is again called for In this new edition a section on the diseases and treatment of the labyrinth, elaborately illustrated and, in all, amounting to several chapters, has been added A great part of the work has also been entirely rewritten, in some cases with collaboration of other authors Thus the chapters on vaccines and the His-leucocyte extract for the treatment of various infections, chapters on the functional tests of hearing and on meningitis and brain abscess are in this edition found to have received especial additional attention at the hands of the author and his associates The recent experience of otologists with salvarsan in syphilitic disease of the acoustic nerve and the brain is fully elaborated in this edition Though autogenous vaccines for the treatment of hay fever are still on trial, the methods employed by the advocates of this form of therapy are detailed Operations devised and extensively employed since the last edition of the work appeared have been included, together with the illustrations of the originators of new operations The work may therefore be said to make good the claim of the author, that "it covers the field"

A MANUAL OF DISEASES OF THE NOSE AND THROAT By CORNELIUS G COAKLEY, A M , M D , Professor of Laryngology in the College of Physicians and Surgeons, Columbia University Fifth edition, revised and enlarged Lea & Febiger New York and Philadelphia, 1914 12mo, 615 pages

THE author of this manual has evidently aimed to dispense with all unessential detail in its preparation, and give in a terse, compact manner a presentation of the art of rhinology and laryngology as he himself

practices it. Thus, instead of an encyclopædic review of the various operations which may be performed for a given condition, the writer has presented only those medicinal and operative measures which, in his judgment, are the best. This method of presentation has been adhered to throughout. This work has, then, this advantage to the beginner and practitioner, that the reader is brought to the clinic of the author, as it were, and as he reads, mentally proceeds step by step with him through the transactions by which the author arrives at a diagnosis and by which he applies the medicinal and operative remedies. By no chance is he confused by any multitude of detail, or by a seeming choice of operative procedures. That the author's method of presenting the subject has been widely approved is shown by the issue of this, the fifth, edition of his work.

A TEXT-BOOK OF THE DISEASES OF THE NOSE AND THROAT. By JONATHAN WRIGHT, M.D., Director of the Department of the Laboratories, New York Post-Graduate Medical School and Hospital, and HARMON SMITH, M.D., Surgeon to Throat Department of the Manhattan Eye, Ear, Nose and Throat Hospital. Lea & Febiger. Philadelphia and New York, 1914. Roy 8vo, pp. 1-xii, 17-683.

In a review of this work a very few of the apparently most characteristic features which distinguish it from others of its class are herewith unconnectedly detailed. Many of the more useful of the lately-devised and improved instruments and necessities for the office equipment of the up-to-date specialist, including tables, chairs and new instruments, are described and illustrated with great thoroughness and fulness.

The authors believe the X-ray photograph, as an aid to diagnosis of the diseases of the accessory nasal sinuses, is to be relied upon only as an accessory to other clinical facts. As an operative aid it is valuable in that a side view X-ray photograph outlines the distance between the inner and outer plates of the frontal sinuses and likewise the anteroposterior diameter of the sphenoidal sinus. The authors recommend that two views, *i.e.*, front and side, should both be taken, believing that the anatomical outlines of the sinuses in the individual case thus obtained are useful in every contemplated external operation, for the purpose of fixing the limits and ramifications of the walls of the frontal. We regret that the authors have not included specific directions for the taking of the X-ray photographs. The definition of the relative positions of the X-ray plate and of the head, at the time of exposure of the photo plate, is very important for obtaining the best

## BOOK REVIEWS

results, both in the matter of bringing out the shadows and also for showing the limits of the sinuses

The portion of the work devoted exclusively to the larynx includes pp 448 to 544. In this, approximately, 100 pages are included chapters or paragraphs on the gross and minute anatomy, the acute and chronic inflammations, the benign and malignant neoplasms and the operations employed for diseases of the larynx. Much matter on the larynx is also contained in the succeeding chapters devoted to the throat in general diseases, especially those on syphilis and tuberculosis. The word pictures of syphilis of the throat, including primary chancre, the mucous patch, the gumma, differential diagnosis, demonstration of the spirochæta, treatment of laryngeal syphilis and treatment of tertiary syphilis, leave little to be desired, since they cover the field thoroughly, while the graphic style of the authors, especially in this portion of the work, seems, to the reviewer, altogether commendable. Though we would welcome more matter devoted to the treatment of the larynx by the Killian-Jackson direct method, we wish to praise especially the section on the larynx which is, we think, the best in this respect of American text-books of the present period.

WILLIAM C BRAISLIN

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